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With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLIV.—No. 3746] LONDON: FRIDAY EVENING, OCTOBER 28, 1927 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. TWO 85ft. ENGINE TURNTABLES.
2. TWO LATHES, one 60in. LOCO WHEEL, and one 37in. WAGON WHEEL, Motor Driven, Two Headstock or Central Drive Type.
3. 7 SLOTTING MACHINES, belt driven.

Tenders due on the 18th November, 1927, for No. 1, on the 22nd November, 1927, for No. 2, and on the 30th November, 1927, for No. 3.

Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6893

Civil Engineers and ARCHITECT REQUIRED by the GOVERNMENT of IRAQ.

M/223.—IRRIGATION ENGINEERS (3 Vacancies).—Two years on probation, leading, in the case of satisfactory service, to a ten years' contract. Salary Rs. 650, rising to Rs. 800 a month by annual increments of Rs. 50 a month. Candidates, unmarried and between 23 and 26 years of age, should have passed Sections A and B of the A.M.I.C.E. examination or hold an exempting University degree, and have had not less than a year's practical experience.

M/226.—ASSISTANT ENGINEERS (2 Vacancies).—Three years' engagement. Salary Rs. 650, rising to Rs. 800 a month by annual increments of Rs. 50 a month. Candidates, unmarried and between 23 and 26 years of age, should have passed Sections A and B of the A.M.I.C.E. examination, or hold an exempting University degree, and have had experience on roads or bridges or municipal work.

M/228.—ASSISTANT ARCHITECT (1 Vacancy).—Three years' engagement. Salary Rs. 650, rising to Rs. 800 a month by annual increments of Rs. 50 a month. Candidates, unmarried and between 23 and 28 years of age, should have passed the examination to qualify for the A.R.I.B.A. Diploma or possess equivalent professional qualifications, and have had not less than two years' experience of buildings.

M/252.—EXECUTIVE ENGINEER (1 Vacancy).—Salary Rs. 1000 to 1200 (according to qualifications), rising to Rs. 1800 a month by annual increments of Rs. 75 a month. Candidates, between the ages of 28 and 35, must be A.M.I.C.E. or hold equivalent professional qualifications, and have had considerable experience of general civil engineering, including municipal roads, lighting, &c. This appointment may lead to a ten-year engagement.—Apply at once by letter, stating age, qualifications and experience to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, and quoting clearly the reference number of the appointment for which application is made. 6872

TRACER.

Applications are INVITED for the POSITION of LADY TRACER at the Admiralty Engineering Laboratory, West Drayton, Middlesex. Candidates should be at least 21 years of age and fully qualified.

The maximum commencing salary is 44s. per week, according to experience, and will be subject to variation with the cost of living index figure.

Apply, enclosing sample of work and stating age and experience, to the SUPERINTENDENT. 6846

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory, and he has not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the Examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience in Civil Engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience, and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 6769

The High Commissioner for India is prepared to receive APPLICATIONS for SIX APPOINTMENTS as CIVIL ENGINEERS, Burma Public Works Department, Buildings and Roads Branch. The appointments will be made temporarily on agreement for five years in the first instance, with the prospect, subject to satisfactory service, of transfer to permanent employment.

Candidates must be between 22 and 24 years of age and unmarried. They must have either (1) obtained a recognised university degree; or (2) passed Sections A and B of the A.M.I.C.E. examination; or (3) passed the Associateship in Civil Engineering of the City and Guilds Institute (Imperial College of Science and Technology) or obtained such other diploma or distinction in engineering as may be considered acceptable. In addition, at least one full year's practical experience of civil engineering under a qualified civil engineer is required.

The commencing pay will be Rs. 300 a month, rising by annual increments of Rs. 50 a month, plus overseas pay £20 a month. Overseas pay is admissible only to officers of non-Asiatic domicile.

Further particulars and forms of application may be obtained on request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 7th November, 1927. 6775

The Engineer

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PUBLIC NOTICES

Assistant Engineer REQUIRED by the GOVERNMENT of SIERRA LEONE for the Railway Department for two tours of from 12 to 18 months' service, with possible extension. Salary, £480 for the first three years of service, then £510, rising to £920 a year by annual increments. Outfit allowance of £60 on first appointment. Free quarters and first-class passages. Liberal leave on full salary. Candidates, 25 to 35 years of age, must have had good experience as Civil Engineers on Railway Maintenance preferably in the tropics, and should have had practical experience of building construction and steel work erection.—Apply at once in writing, giving brief outline of qualifications and experience, and stating age, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/73. 6894

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, E.C. 1.

DEPARTMENT OF APPLIED CHEMISTRY.

A Course of FIVE LECTURES on 'STEEL AND ITS THERMAL TREATMENT" will be given by R. GENDERS, Esq., M.B.E., B.Met., F.I.C., On Thursday Evenings, at 7 p.m., commencing November 3rd, 1927. The Lectures form part of the sessional course in Advanced Metallurgy and will deal with the following subjects :—

November 3rd: Wrought Iron, Shear Steel, Crucible and Electric Furnace Steels.
November 10th: The Heat Treatment of Carbon Steels.
November 17th: The Properties and Heat Treatment of Engineering Alloy Steels.
November 24th: Special Purpose Steels (High Speed, Stainless, &c.).
December 1st: Cast Iron and Malleable Cast Iron.

Fee for the course 5s.

S. C. LAWS, M.A., M.Sc., Principal. 6862

PUBLIC NOTICES

County Borough of Barnsley EDUCATION COMMITTEE.

MINING AND TECHNICAL COLLEGE.

PRINCIPAL: D. PATON GRUBB, A.R.S.M., M.Eng., &c.

APPOINTMENT OF FULL-TIME TEACHER IN MECHANICAL ENGINEERING.

The Higher Education Committee invite APPLICATIONS from fully qualified persons for the POSITION of FULL-TIME TEACHER in MECHANICAL ENGINEERING SUBJECTS. Salary in accordance with the Burnham Scale for Technical Teachers. Full particulars regarding the position may be had upon application to the Principal.

E. DAVIES, Director of Education. 6795

Borough of Weymouth and Melcombe Regis.

TOWN BRIDGE RECONSTRUCTION, GENERAL CONTRACT.

TENDERS are INVITED for the GENERAL WORK to RECEIVE and SUPPORT a TWO-LEAF BASCULE BRIDGE, including Foundations in the harbour supporting Stone-faced Reinforced Concrete Walls, Parapets, Control House, &c., Temporary Footbridge, Roadway Widenings on Reinforced Concrete Piles and Platform. The steel bridge is being tendered for separately and is to be embodied in this general contract as a sub-contract.

Drawings are prepared and can be seen at the office of the Engineer for the work, Mr. H. W. Fitzsimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster, S.W. 1. Copies of the specification, bill of quantities, and form of Tender are to be obtained from the Engineer's office on payment of Three Guineas, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Tenders are to be sent to the undersigned not later than Noon on Monday, the 31st October, and endorsed "W.T.B.G.C."

The Corporation does not undertake to accept either the lowest or any Tender.

P. SMALLMAN, Town Clerk.

Town Clerk's Office, Weymouth. 6749

PUBLIC NOTICES

The Institution of Mechanical ENGINEERS.

THOMAS HAWKSLEY LECTURE, 1927.

Sir WILLIAM H. BRAGG, K.B.E., F.R.S., will deliver the above Lecture on "APPLICATION OF X-RAYS TO THE STUDY OF THE CRYSTALLINE STRUCTURE OF MATERIALS," at the Institution, Storey's-gate, Westminster, on Friday, 4th November, 1927, at 6 p.m.

VISITORS ARE INVITED.

The Lecture will be repeated in Sheffield on 9th November, in Leeds on 10th November, in Bristol on 16th November, in Manchester on 17th November, in Glasgow on 1st December, and in Birmingham on 15th December. 6843

City of Cardiff Corporation. TO CONDENSING PLANT MANUFACTURERS.

The Corporation invites TENDERS for the RECONSTRUCTION of the CONDENSING PLANT at the Pumping Station of the Western District Main Outfall Sewer.

Copies of specification, form of Tender and drawings can be obtained from the office of Mr. G. H. Whitaker, M. Inst. C.E., City Engineer, City Hall, Cardiff, on and after Saturday, 5th November, 1927.

Tender, enclosed in sealed envelope and clearly endorsed "Tender for Condensing Plant," to be delivered at the office of the Town Clerk at the City Hall by Tuesday, November 15th, 1927.

The lowest or any Tender will not necessarily be accepted.

CECIL G. BROWN, Town Clerk.

City Hall, Cardiff, 26th October, 1927. 6843

County Borough of Brighton. PATCHAM PUMPING STATION EXTENSION. CONTRACT NO. 5.

TALL CHIMNEY AND ALTERATIONS TO BOILER-HOUSE.

The Corporation invite TENDERS for the ERECTION of a TALL CHIMNEY, 120ft. high, SEATINGS and FLUES for TWO NEW BOILERS, ECONOMISER SETTING, and ALTERATIONS and ADDITIONS to the existing BOILER-HOUSE at their Pumping Station, Patcham, near Brighton.

Drawings may be seen and copies of the general conditions, specification, bills of quantities and form of Tender may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, accompanied by a deposit of £5, which will be refunded upon receipt of a bona fide Tender not subsequently withdrawn and the return of all the documents.

Sealed Tenders, endorsed "Tender for Chimney, &c., Patcham Pumping Station," must be delivered to me on or before 14th November, 1927.

JAS. H. ROTHWELL, Town Clerk.

Town Hall, Brighton, 18th October, 1927. 6796

County Borough of Dublin. TENDERS FOR STEEL PIPES AND CASTINGS.

The Dublin Borough Commissioners invite TENDERS for the SUPPLY and DELIVERY of STEEL PIPES and CASTINGS, 24in. and 18in. in diameter.

Particulars and conditions of contract may be obtained on application to the Borough Surveyor, 29, Castle-street, Dublin.

Sealed Tenders endorsed "Tender for Steel Pipes and Castings," should be addressed to the Dublin Borough Commissioners and delivered at the office of the Waterworks Section, 29, Castle-street, Dublin, on or before the 14th day of November, 1927.

The lowest or any Tender will not necessarily be accepted.

GERALD J. SHERLOCK, Town Clerk.

City Hall, Dublin. K.A.A. 6848

Egyptian State Railways, Telegraphs and Telephones.

SALE of 3ft. 6in. Gauge ROLLING STOCK from Luxor-Assuan Railway :—24 Locomotives, 66 Carriages, 179 Wagons (both bogie and 4-wheeled), and Spares for same will be Sold by Sealed Tenders in December next.—Detailed catalogue available from the CHIEF INSPECTING ENGINEER, 41, Tothill-street, London, S.W. 1, or from the STORES DEPARTMENT, Saptieh, Cairo. All stock and spares may be inspected at Luxor, Egypt. 6840

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PUBLIC NOTICES

Corporation of Durban, Natal.

The Corporation of Durban, Natal, is prepared to receive TENDERS (from manufacturers only) for the SUPPLY and DELIVERY, Free on Board Port for shipment to South Africa, of ONE 500 kVA. 6600-Volt Delta/11,000 Volts Star TRANSFORMER.

The Consulting Engineers, to whom application for technical information may be made, are Messrs. Mers and McLellan, 32, Victoria-street, Westminster, London, S.W. 1.

Specifications can be obtained from, and sealed and endorsed Tenders must be delivered to, the undersigned on or before November 7th, 1927. The charge for four copies of specification is Three Guineas, which will be refunded on receipt of a bona fide Tender.

The lowest or any Tender will not necessarily be accepted.

By Order,
WEBSTER, STEEL & CO.,
36, Leadenhall-street, London, E.C. 3,
6841 Agents to the Durban Corporation.

Great Southern Railways.

The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of—

FINISHED WAGON WORK MATERIAL.

The form of Tender has been divided into five sections, as follows:—

Section 1.—WHEELS and AXLES Complete and SPRINGS.
" 2.—AXLE-BOXES Complete.
" 3.—BODYWORK, UNDERFRAME WORK, BRAKE WORK.
" 4.—CAST IRON WORK.
" 5.—ROOFING.

The drawings for all the items in each section, together with the specification and form of Tender (on which alone offers will be considered), can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of 5s. per section.

Tenders should be forwarded so as to reach the undersigned not later than 5 p.m. on Wednesday, November 16th, in the envelope provided for the purpose.

The Directors do not bind themselves to accept the lowest or any Tender.

C. E. RILEY,
Secretary.
Kingsbridge Station, Dublin,
October, 1927. 6888

Metropolitan Water Board.

MAINS FOR THE SUPPLY TO CHESHUNT.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of the following CAST IRON MAINS, together with CONNECTIONS and CONTINGENT WORKS:—

6220 Lineal Yards of 20in. Diameter Main in Cambridge-road, from Hoe-lane to Brookfield-lane.
400 Lineal Yards of 14in. Diameter Main in Brookfield-lane, from Cambridge-road to the Board's Pumping Station.
600 Lineal Yards of 12in. Diameter Main in Brookfield-lane, from the Board's Pumping Station to Longfield-lane.

in the Urban Districts of Enfield and Cheshunt.

The drawings and contract documents may be inspected without charge at the Offices of the Board, Chief Engineer's Department (Room 201).

Forms of Tender, conditions of contract, specification and bills of quantities, together with drawings and a spare copy of the bills of quantities may be obtained on and after Monday, 24th October, 1927, from the Chief Engineer, on production of an official receipt for the sum of £10, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Mains for the Supply to Cheshunt," must be delivered at the offices of the Board (Room 122) not later than 10 a.m. on Monday, 21st November, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Offices of the Board: Clerk of the Board.
173, Rosebery-avenue, E.C. 1,
6th October, 1927. 6792

Port of Bristol Authority.

EXTENSION OF THE ROYAL EDWARD DOCK, AVONMOUTH.
TEN 2-TON ELECTRIC MOVABLE ROOF CRANES, SHEDS "U" AND "V."

The Port of Bristol Authority is prepared to receive TENDERS for TEN 2-TON ELECTRIC MOVABLE ROOF CRANES for Sheds "U" and "V," Royal Edward Dock, Avonmouth.

On and after Monday, the 31st October, 1927, copies of the specification and contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid. ALL CHEQUES MUST BE MADE PAYABLE to the "PORT OF BRISTOL AUTHORITY" and forwarded to the General Manager and Secretary, Dock Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Ten 2-Ton Electric Movable Roof Cranes," addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him before 10 a.m. on Monday, the 28th day of November, 1927.

The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.
Chief Engineer's Office,
Avonmouth Docks, Bristol,
28th October, 1927. 6877

The South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

1. TIN INGOTS (17½ Tons).
2. METALS.
3. BEST YORKSHIRE IRON.
4. MILD STEEL BARS, SECTIONS, &c.
5. STEEL CRANKED FISH-PLATES.
6. SPRING STEEL.
7. GALVANISED SHEETS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Tin Ingots," or as the case may be, must be left with the undersigned not later than Twelve Noon on Thursday, the 10th November, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. each for Specifications Nos. 1 to 5; of 5s. for Specification No. 6; and of 2s. 6d. for Specification No. 7.

Copies of the drawings may be obtained from the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 5, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France,
London, S.W. 1.
26th October, 1927. 6891

West Ham Union.

The Guardians have FOR DISPOSAL a QUANTITY of SECOND-HAND ELECTRICAL MACHINERY, comprising Generators and Motors. Persons and firms interested should forward their names and addresses to the CLERK TO THE GUARDIANS, Board Room, Union-road, Leytonstone, E. 11, when a list of the machinery will be furnished.
6884

PUBLIC NOTICES

West Ham Union.

The Guardians invite TENDERS for CARRYING OUT ALTERATIONS and ADDITIONS to the ELECTRIC LIGHTING and POWER MAINS at their Central Home, Union-road, Leytonstone, E. 11.

Persons and firms desirous of tendering should forward their names to the undersigned, when a specification of the work will be supplied.

L. E. FRAQUET,
Clerk.
Board Room, Union-road,
Leytonstone, E. 11,
26th October, 1927. 6885

Corporation of Rangoon.

FIRE BRIGADE DEPARTMENT.
WANTED, ENGINEER OFFICER (FIRE FLOAT).

Salary Rs. 400 per month for the first year, rising by annual increments of Rs. 20 per month to Rs. 500 per month. Free quarters, lights, motor car allowance or service car provided. Applicants should state their age, height, nationality, address and present employment, qualifications and previous engineering or fire brigade experience, accompanied by testimonials, stating class of membership of I.F.E., or Institutions, if any. Thorough knowledge of Internal Combustion Engines essential.

The successful applicant will be required to pass a medical examination by Medical Officer appointed by the Corporation and conform to the rules and regulations in force for the officers of the Rangoon Corporation.

He will be on probation for one year from the date of his appointment and be required to sign an agreement for five years on confirmation. He may be required to stay in London during the completion and trials of the new motor fire float, on full pay without allowances. Half-pay will be paid on voyage out. Free passage on Henderson Line to Rangoon and free return at termination of probation or at end of service.

Applications to be forwarded to the undersigned and should reach them not later than the 20th of November, 1927.

All applications will be forwarded to Rangoon for final selection.

OGILVY GILLANDERS & CO.,
Ref. 2706,
6870 Sun-court, Cornhill, E.C., London.

Egyptian State Railways, Telegraphs and Telephones.

REQUIRE the SERVICES of a SIGNAL INSPECTOR for the Engineering Department at a salary of £E420 to £E600, according to capabilities. Selected candidate would be appointed for a period of 2 years. Qualifications required: knowledge of Electro-Pneumatic Signalling, at least ten years' experience in Railway Signalling and experience of Westinghouse Interlocking Frames, 1925 type, and also be fully acquainted with the erection of new Signalling Installations. Age between 25 and 35, single, if possible.—Application form can be obtained from the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, S.W. 1. Forms must be forwarded to him, marked "Signal Inspector."
6835

Karachi Port Trust.

APPLICATIONS are INVITED by the Trustees of the Port of Karachi for the POST of SUPERINTENDENT of MACHINERY.

Applicants must have served a full apprenticeship in some recognised Engineering and Shipbuilding Works and must hold a First Class Engineer's Board of Trade or Colonial Certificate. Age should be about 35 years.

Applicants must have had extensive experience in ship construction and repair, and general dockyard work, and also in the working and maintenance of dredgers, tugs, floating craft, and port equipment.

The salary is Rs. 900-50-1100 per mensem, with free quarters.

The successful applicant will be on probation for six months. If confirmed, he will be required to enter into a five years' agreement, which will include the six months' probationary period.

He will have to conform to all Port Trust Rules and to contribute to the Provident Fund.

A first-class free passage to India will be provided, with a return passage home on satisfactory termination of services.

Applications, with references and copies (which will not be returned) of testimonials, and stating age, parentage, nationality, and giving particulars of training and experience, will be received by the undersigned not later than 18th November, 1927.

RENDEL, PALMER & TRITTON,
6873 12-15, Dartmouth-street, London, S.W. 1.

Lewisham Union.

WORKING ELECTRICIAN.

The Guardians of the Lewisham Union invite APPLICATIONS from suitable persons not over the age of 45 for the POST of WORKING ELECTRICIAN at the Lewisham Hospital.

Applicants must be fully competent to deal with the electrical work arising in a large Institution and, other things being equal, preference will be given to candidates having Institutional experience.

The remuneration for the post will be at the rate of £4 10s. per week, and the appointment will be subject to the provisions of the Poor Law Officers' Superannuation Act, 1896.

Applications upon forms to be obtained from this office by sending a stamped addressed foolscap envelope, must be returned so as to reach the undersigned by not later than 10 a.m. on Wednesday, the 9th November, 1927.

Canvassing the Guardians, directly or indirectly, is prohibited and will be deemed a disqualification.

By Order,
W. R. OWEN,
Clerk to the Guardians.
Guardians' Offices:
394, High-street, Lewisham, S.E. 13,
20th October, 1927. 6833

Lewisham Union.

ENGINEER-IN-CHARGE.

The Guardians of the Lewisham Union invite APPLICATIONS from suitable persons not over the age of 45 for the POST of ENGINEER-IN-CHARGE at the Lewisham Hospital.

Applicants must possess the necessary qualifications, and the person to be appointed will be required to take charge of the Boiler and Power-house Plant at the Lewisham Hospital and to be responsible for all Engineering and Sanitary Work in the Guardians' establishments.

The remuneration assigned to the post will be after the rate of £6 per week plus dinner and tea daily, valued at £23 8s. per annum; and the appointment will be subject to the provisions of the Poor Law Officers' Superannuation Act, 1896.

Forms of application, together with a list of duties, can be obtained from this office by sending a stamped addressed foolscap envelope, and completed applications must be returned so as to reach the undersigned by not later than 10 a.m. on Wednesday, the 9th November, 1927.

Canvassing the Guardians, directly or indirectly, is prohibited and will be deemed a disqualification.

By Order,
W. R. OWEN,
Clerk to the Guardians.
Guardians' Offices:
394, High-street, Lewisham, S.E. 13,
20th October, 1927. 6834

Taf Fechan Water Supply Board.

APPOINTMENT OF ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of full-time ENGINEER to the above Board.

Salary £300 per annum, rising by annual increments of £25 to £400 per annum, together with house (including rates and electric light), situate at Pontsticill, near Merthyr Tydfil.

Application forms and information as to the Board's undertaking may be obtained from the undersigned, to whom the forms must be returned not later than 7th November, 1927.

Canvassing will be regarded as a disqualification.

J. COLENSO JONES,
Clerk to the Board.
Board's Offices:
101, High-street, Merthyr Tydfil. 6863

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Fully Experienced PRACTICAL ENGINEER, who has held some responsible position. The man must be accustomed to the Maintenance of General Works Plant, including Engines, Electrical Installation, Machines and Motor Vehicles. Statistics will be required to be kept in detail of working costs, &c. None other but really competent men need apply. The salary to be paid is approximately £300 per annum.—Address, stating experience, age, &c., 6811, The Engineer Office. 6811 A

WANTED, WORKS MANAGER, Age Under 40, accustomed to the control of men, who can work to cost, with drawing office experience, knowledge of Internal Combustion Engines. Salary £500 per annum.—Address, stating experience, &c., P3794, The Engineer Office. P3794 A

ACTIVE DIRECTORSHIP OFFERED in Midlands district to man of good type with Works Connections. Experiences Gauging and Production Methods essential.—Write, Box 417, Sells, Fleet-street, E.C. 4. 6737 A

ENGINEER, with Thorough Experience of Elevating and Conveying Machinery, WANTED as whole-time REPRESENTATIVE in Sheffield district.—Address, stating age, past experience, and salary required, 6886, The Engineer Office. 6886 A

ENGINEERING SALESMAN REQUIRED for Calcutta. Age 23-25, unmarried. Must be qualified engineer and have had experience in selling engineering supplies. First agreement 5 years on progressive salary, commencing at Rs. 550 per month.—Write, Box No. 324, c/o Judds, 47, Gresham-street, London, E.C. 2. 6869 A

EXPERIENCED DEPARTMENTAL MANAGER WANTED to TAKE CHARGE of Plant Manufacturing Forged and Rolled Wheel Centres for Railway Work. Good organiser essential.—Address, giving full particulars of age, qualifications, testimonials and salary required, to 6860, The Engineer Office. 6860 A

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Sir Henry Fowler's Address.

In proposing the vote of thanks to Sir Henry Fowler for his presidential address at last Friday's meeting of the Institution of Mechanical Engineers, Sir John Aspinal, under whom Sir Henry served his apprenticeship at Horwich, reminded the members that it was eighty years since George Stephenson had occupied the presidential chair. During that period, Sir John said, there had been forty-two Presidents, and of them he had known thirty-three personally. Seven of their number had been locomotive engineers. Forty years ago, he continued, our locomotive superintendents became chief mechanical engineers, a fact indicating that their duties had become wider than those which they had to perform in earlier days. They had no longer to be simply locomotive engineers, but had to know something of many sciences, including chemistry and electricity. To-day, the chief mechanical engineer to the L.M.S. Railway had under his charge the works at Crewe, Derby, Horwich and St. Rollox, besides other smaller establishments. At each of these works there was a fully equipped chemical laboratory and testing department, which afforded facilities for much valuable research work. The general public, Sir John thought, did not take sufficient interest in the inner working of our railways, nor realise the immense responsibility resting on the chief mechanical engineers. In this country about 120,000 artisans, excluding labourers, were directly employed in the manufacture, upkeep and repair of railway rolling stock, and in making it and keeping it in a condition ensuring freedom from accidents.

Large Grain Handling Plant Contract.

The Buenos Aires Great Southern Railway has decided to proceed immediately with a big scheme for the improvement of the grain-handling and storage facilities at Ingeniero White, Bahia Blanca, in the Argentine Republic. The work to be undertaken will cost a little over £1,000,000, and will include the erection of a huge reinforced concrete granary, having a capacity of 80,000 tons of grain, an extensive unloading plant capable of dealing with twenty-four 45-ton railway trucks at once, and an elaborate system of mechanical belt conveyors, by means of which it will be possible to load grain to ships at the rate of 6000 tons per hour. The whole contract, with the exception of certain railway work and foundations, will be carried out by Henry Simon, Ltd., of Manchester. Means will be provided for handling all railway trucks as they arrive at one central point without sorting and without the use of temporary storage sheds or the necessity for re-handling. These means will expedite the railway work and will release rolling stock much more quickly than at present. They will also obviate the great amount of shunting which is necessary under existing conditions. The improved storage accommodation and loading-out facilities will, in addition, speed up the work of transferring the grain to ships and will expedite generally the handling of the harvest. When the plant is in operation it will be possible to load eight ships at one time. The whole plant will be electrically driven, involving the use of something like 150 separate motors, totalling 10,500 H.P. Messrs. Simons' contract is valued at £800,000, and includes the transformer sub-station, electric lighting equipment, telephones, and a special system of signalling to facilitate the rapid working of the granary.

British Industries and the Cost of Living

Speaking on Monday last at the general meeting held in Sheffield of the United Steel Companies, Ltd., Mr. A. O. Peech, the chairman, said that in his view we were maintaining in this country a cost of living and a standard of living higher than could be justified by the present conditions of industry. We could, he continued, maintain those standards only by providing more work for, and increased employment of, labour in the unsheltered exporting trades. The cost of the difference between the true economic standard and the artificially high standard of living existing in the country to-day was, he averred, being met largely out of the reserves which those industries had accumulated during past years when the governing conditions were entirely different from those of the present time. A readjustment was, he maintained, bound to take place. It would be wrong to suppose from this quotation that Mr. Peech's remarks were of a generally pessimistic nature. On the whole, they conveyed the belief that our heavy industries are in a less desperate condition than some reports, and the remarks of some other speakers, would imply. He endeavoured to show that the position of the iron and steel industry has been brought about by circumstances beyond the control of those engaged in it. The governing factors were the artificially enlarged output capacity brought about by the war and the reduction of purchasing power consequent upon the war. The adjustment of these two factors, he said, was a matter of time, and was really an economic problem upon which our efforts could have but little effect. Dealing with British output and foreign competition, he said that our production of steel during this year would probably be about 9½ million tons, or about 80 per cent. of the country's capacity. The demand for the remaining 20 per cent. already existed, as was clearly implied by the fact that our importations of steel from the Continent during the current year would probably amount to 4 million tons, or 1½ million tons more than would be required to keep our steel works engaged to their full capacity.

Induced and Atmospheric Charges in Transmission Lines.

The Washington correspondent of a London daily paper reported this week that a man had been killed by "induced static" while working on a Maryland power transmission line. The line ran parallel with a live high-tension line, but was itself supposed to be dead at the moment when the man, grasping it, was instantly killed. The correspondent reported that, according to the authorities who investigated the mishap, the line had become charged under the atmospheric conditions that existed. The phenomenon had, he added, never been encountered before, and its occurrence opened up a new field for research. To this message our contemporary's "science correspondent" added a note in which he described the accident as inexplicable. The mishap is neither inexplicable nor unprecedented. In underground cables the pnenomenon known as retained capacity can be responsible for the existence of a heavy charge in a supposedly "dead" system. In overhead lines a heavy charge in the "dead" state may accumulate either by induction from a neighbouring line carrying high-tension alternating current or, so it is said, by the action of the wind against the line. It is not even safe to assume that because one end of a long line is earthed, the other end will be free from an induced or atmospheric charge. It is, indeed, so well recognised that danger may exist in "dead" transmission lines that any workman who before touching such a line failed to take the precaution of earthing it at or near the point at which he was to work on it would, in this country at any rate, make himself liable to severe censure by his employers.

Launch of the Cruiser Devonshire.

On Saturday, October 22nd, the cruiser Devonshire was launched at Devonport Dockyard. This vessel is the second of the four cruisers of the 1925 programme to take the water, the London having been launched at Portsmouth on September 14th. Including the two Australian vessels built on the Clyde, nine large cruisers of post-war construction are now afloat, and five more are on the stocks. The vessels of the "London" class, to which the Devonshire belongs, were designed by Sir W. J. Berry, the Director of Naval Construction. They differ in certain details from the "Kent" type, for which Sir E. T. d'Eyncourt was responsible. The displacement is the same, viz., 10,000 tons, and each type has a length of 590ft., but in the "Londons" the beam has been reduced from 68ft. 4in. to 66ft., while the shaft horsepower has been raised from 80,000 to 90,000, and the designed speed from 31½ knots to 32. It is understood that no change has been made in the main armament, which will therefore consist of eight 8in. guns. As the keel of the Devonshire was laid on March 16th, 1926, it has taken over nineteen months to bring her to the launching stage. The London was on the slipway for a like period. The completion of a 10,000-ton cruiser now occupies approximately three years. It may be doubted whether this slow rate of construction could be defended on the grounds of economy. Before the war capital ships up to 27,000 tons were completed for the British Navy within two years. The launching weight of the Devonshire was 4600 tons. Her cost up to next March is estimated at £1,292,397, leaving a further sum of about £700,000 to be expended on completing her. According to the Navy Estimates, the total cost, inclusive of guns, of the first five "County" cruisers averaged £1,970,250. The dockyard-built ships cost considerably more than those built by contract.

The Work of the B.E.S.A.

The report covering the activities of the British Engineering Standards Association's twenty-sixth year, which was submitted at last week's annual general meeting of the body, reveals by a few figures the striking growth which has taken place in the Association's work. The Association dates its origin from 1901, when a Committee was appointed by the Institution of Civil Engineers to standardise steel sections. It now covers the working of 502 committees and subcommittees, the activities of which are carried on by 2600 honorary members. During the year ending March 31st last, these committees held something like 400 meetings. The number of specifications sold during the year, exclusive of a large number of complimentary copies, was 64,827, in addition to which 21,417 aircraft specifications were distributed on behalf of the Air Ministry. We regret to notice that the Association again completed its financial year with a deficit, but are glad to observe that thanks to certain new and increased subscriptions, the deficit has been reduced by some £640 to a matter of £1880. The report mentions the suggestion made by the Government to the Association that it should extend its standardising activities outside its present scope covering the engineering and allied industries. The Main Committee has definitely decided against the suggestion. At the same time, it decided to effect a reorganisation of the Association on a wider and stronger basis, and to that end is taking steps to obtain a Royal Charter. Another important matter touched upon in the report is the question of international standardisation. A committee of seven, under the chairmanship of Sir Archibald Denny, was appointed to act pending the final constitution of the proposed International Standards Association at a conference in New York in April last year of eighteen national standardising bodies. The attitude of the B.E.S.A. towards the work of that Committee may be summed up by saying that it does not intend to be left behind in the matter of international standardisation, but that it will only agree to adopt international proposals that carry the full support of all parties in this country.

A New Motor Vessel Launched.

An interesting launch took place on the Clyde on Tuesday, October 25th, when the Dunster Grange, a shelter-deck passenger and cargo motor vessel built by the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, to the order of the Houlder Line, Ltd., safely took the water. The new ship has a length between perpendiculars of 430ft., with a breadth moulded of 64ft. 3in., and a depth moulded of 38ft. 3in. to the shelter deck. She has a measurement of about 9100 tons gross, and is intended for the carriage of chilled meat between the River Plate and Great Britain. The hull is divided into fifty-four refrigerated compartments, having a total capacity of 500,000 cubic feet, with an additional 3000 cubic feet for ships stores. Twin-screw propelling machinery of the Fairfield-Sulzer type will be fitted, with a designed output of 6400 B.H.P., giving the vessel a speed of 14½ knots. The Dunster Grange will be generally similar to the Upway Grange, already described in The Engineer, and these two Houlder liners will be the largest and most powerful motor-propelled refrigerated vessels yet constructed. After the launch Sir Alexander Kennedy, the chairman of the Fairfield Shipbuilding and Engineering Company, Ltd., proposed success to the new ship and referred to the reasonable hope for a steady, if slow, improvement in the shipbuilding trade which now existed. He said that a good beginning had been made in the co-operation between employers and the trade unions, and appealed for still closer co-operation in the direction of reducing building costs.

Conference on Methods of Coal Analysis.

In our "Journal" page in our issue of October 7th we noted that at the request of the Department of Scientific and Industrial Research, the British Engineering Standards Association had arranged to call a conference to discuss the adoption of British national standard methods of coal analysis. That conference was held on Tuesday of this week at the Institution of Civil Engineers under the chairmanship of Sir Richard Glazebrook. It was attended by representatives of the Mining Association of Great Britain, the Coal Merchants' Federation, Government Departments, the London County Council, the railway companies, coal exporters and engineering institutions. The conference decided to set up a committee to make recommendations for the commercial analysis and sampling of coal. It was generally held that standard methods of analysis and sampling would be of particular benefit to the export market, and that the proposed standardisation would assist foreign buyers to judge the value of tenders on a calorific basis.

Proposed High-speed Atlantic Liners.

Preliminary particulars were recently made known with regard to a scheme for the construction of an American-owned fleet of high-speed Atlantic liners, which will come before the United States Shipping Board on November 19th. The proposal is sponsored by the American Brown-Boveri Company and Mr. Lawrence Wilder, one of its former presidents, and is said to embrace the construction of ten 20,000-ton liners, which will be designed to cross the Atlantic in an even four days. Tests on a 20ft. model of the type of liner proposed have been carried out in the experimental tank at the Washington Navy Yard, with, it is claimed, remarkable results. The model showed its ability to make a speed of 35 knots in conditions simulating a severe Atlantic storm, while improvements in the propelling machinery which are contemplated are said to have shown that speeds considerably in excess of present liner speeds can be obtained, with a less expenditure of fuel and a smaller crew. It is, however, held that before any final judgment can be come to, one of the proposed liners should be constructed, and tested under actual Atlantic conditions, and an application for a loan to construct the ship will be sought. The overall dimensions of the proposed ship have been given as 800ft. in length, 80ft. beam and a depth of 24ft. 9in. The type of machinery to be installed has not been divulged, but it will be designed to give a sustained service speed of 32½ knots.

THE QUEENSTON POWER STATION, ONTARIO

An American Diary.

No. XIV.*

NIAGARA.

As the modern traveller approaches Niagara he suffers a disappointment. No longer does the Redskin, yet 20 miles off, lay his ear to the ground and listen to the roar of the mighty falls; no longer does the Paleface, when yet far distant, wonder what great distress of Nature is forcing strange grumblings and murmurs from her patient lips. Even if the Last of the Mohicans led Fenimore Cooper into Buffalo itself, he would listen in vain for the thunder which sire and grandsire had known for endless generations. It has been swamped and submerged by a greater thunder, the thunder of power, of trains, and trams and motor cars, and the elusive murmur that trembles upwards through the ground from several score of colossal turbines. But if the distant noise of Niagara, which seemed so foreboding to the explorer, has been destroyed, the vision of the great falls has been jealously preserved, and any activities that may threaten the completeness of that wonderful picture are examined with the closest care. There is a constant battle between those who desire to use the waters for the development of power and those who are ever anxious—God bless them and multiply them—to preserve unsullied and undiminished one of the greater beauties of the world. Can both be satisfied? Can we "have our cake and eat it too;" can we even put sugar and almonds on the cake and make it more luscious and desirable than ever? Can we take yet more water from the falls and at the same time increase them. There are those who answer these contradictions in the affirmative.

Their arguments—nay, their demonstrations—are of such interest that we will follow them for a while. Geologists tell us that some thirty thousand years ago there were no falls; possibly, even, in those days, Lake Erie was far less than 327ft. above Lake Ontario, and if the Niagara River existed it was a placid stream stringing the two lakes together. Then a cataclysm fell upon the land and Niagara was made. But it was not near the suspension bridge; it was not near the power station, and the searchlights, and the little shops which sell picture postcards and skins painted with the heads of great chiefs; it was not near the touts who greet the transpontine visitor from the United States and direct him to the best Canadian beer. It was eight miles further down the river; below that gorge where the Rapids whirl onwards with inexorable force, as inevitable as fate, more awe inspiring, more fearful, than the falls themselves; still further down below Queenston, where the finest power station in Canada is nearing completion; down almost to the banks of Lake Ontario. But no sooner were the falls formed than they began eating their way into the rock and advancing themselves ever further and further upstream. In the middle of the seventeenth century, when the first white man saw them, they made a straight line from shore to shore still far below their present site. By 1764, when they were first surveyed, the two falls were already in existence, but the famous Horseshoe was a bare half-circle. Seventy-eight years later the crest of the Horseshoe was 470ft. further upstream; in the next thirty-three years it ate off another 130ft. of the rock; then it devoured 110ft. in thirty-one years, and in the next nineteen years the same amount. And all the time, whilst its crest grows ever longer and longer, the Horseshoe is getting less and less apposite to its name and more and more like an isthmus or gorge. Backwards and backwards it goes, ever growing narrower and narrower. It is moving towards Lake Erie at the average rate of 6ft. a year, lengthening its crest all the time and thereby continually reducing the quantity of water per foot of its length.

TURBINE ROOM, QUEENSTON

Those who want to take more of the water from the upper river advance this argument, that if the flow be reduced the rate of regression will be diminished and the Horseshoe Fall will longer preserve its beauty. But if the quantity of water be reduced the falls must still lose some of their grandeur, and to offset that loss various remedial works have from time to time been proposed. Now arguments "about it and about" took nobody any further; what was wanted was actual demonstration. So the Niagara Falls Power Company built a model, which is claimed to be the biggest in existence. It occupies a large field and is a scale model, as far as the plan is concerned, of the two falls and the upper rapids. Mr. Norman Gibson, of the Power Company, very courteously had the model put into operation for us and demonstrated before our very eyes the effect that certain works which have been proposed would have upon the "scenic grandeur," as the guide books call it, of the Falls. On the opposite page the effect will be seen. In the first picture the model is simulating the falls as they would appear were 100,000 cusecs taken for power and the same amount left for beauty. Actually at the present day about 60,000 cusecs have been harnessed. The American Falls are thin, much thinner than they now in fact are, and the crest of the Horseshoe adjacent to Goat Island is almost bare.

In the next view a weir is seen jutting out from the Canadian shore. It thrusts the water to the left, increases the flow down the American channel, and causes the bare spot in the Horseshoe to fill up. The rapids on the Canadian side have, of course, been diminished, but without much apparent loss. In this picture there is a submerged weir near the Goat Island end of the Horseshoe. In the next view this weir has been replaced by a chain of islands, which are more picturesque and maintain the same conditions.

The last picture shows the model, from another aspect, with these remedial works in use. The clouds of spray or mist which is one of the features of the falls, are simulated in the model by steam, and, as may be guessed from the illustration, the whole effect is remarkably realistic. It is perhaps unnecessary to add that the vertical scale has been exaggerated.

THE QUEENSTON POWER-HOUSE.

There is nowhere in the world such a group of wonderful hydraulic power stations as those which shelter under the high bank of the lower river both

* No. XIII appeared October 21st.

MODEL TO DEMONSTRATE REMEDIAL WORKS AT NIAGARA FALLS

FALLS WITHOUT REMEDIAL WORKS

THE EFFECT OF TWO WEIRS—ONE SUBMERGED

SUBMERGED WEIR REPLACED BY ISLANDS

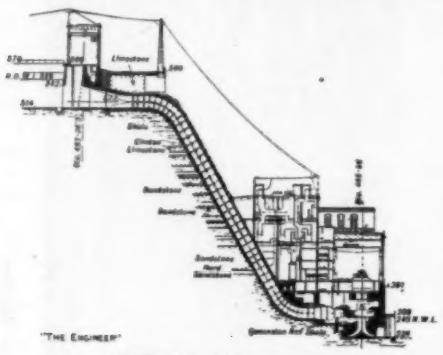
FALLS WITH REMEDIAL WORKS IN USE

on the American and Canadian side. But the most wonderful of them all, and the latest, is far down the river at Queenston, in Ontario. Thither Mr. John Dibblee, of the Hydro-Electric Power Commission, drove us.

The pictorial birdseye view which is shown below will help to a clear understanding of the whole scheme. At the bottom will be seen a river called the Welland. It was a slow stream, of small importance, which fell into the Niagara River above the Falls. Engineers took the lower 4½ miles in hand, improved them in various ways, but, above all, reversed the flow so that no longer did the

BIRDS-EYE VIEW OF QUEENSTON-CHIPPEWA SCHEME

Welland give its waters to Niagara, but subtracted water from that great stream. At a point on the Welland River control works were built, and from them a canal 8½ miles long was led through the country down to the lofty banks of the Niagara River at Queenston. There on the water's edge was erected the magnificent station which is shown by a panoramic view on the preceding page. It contains now nine vertical turbo-generators and is to have yet another. The house itself is 700ft. long and the turbines, seen in the interior view, stand in a long harmonious line. The great penstocks which bring the water to them are each 16ft. in diameter. They are held at



QUEENSTON POWER HOUSE

the top and bottom bends by huge masses of concrete. Their arrangement is better shown by the little sketch above. The maximum head is 305ft., and the turbines, when running at 187½ revolutions per minute, develop 65,000 H.P. Three-phase 25-cycle current is generated at 12,000 volts and stepped up to 110,000 volts for transmission. The head is far greater than that of any other station fed by Niagara; that of the others varies between 130ft. and 210ft. As the fall from Lake Erie to Lake Ontario is about 327ft. Queenston takes far greater advantage of it than any of the schemes, like all the others, which are based almost solely upon the 160ft. maximum head of the great falls. This beautiful and wonderful station, like so many others on both sides of the river, is open to visitors, and is, indeed, a sight well worth seeing. After a glut of huge stations in the United States it was a delight to enter a power-house on the soil of the Empire which is not a whit behind them. It is to be remembered, moreover, that it is but a single item in the wonderful work that is being done by the Hydro-Electric Power Commission of Ontario.

(To be continued.)

Institution of Mechanical Engineers.

EXCERPTS FROM THE ADDRESS BY THE PRESIDENT, SIR HENRY FOWLER, K.B.E., LL.D.

Not only railway engineering, but all branches of our profession have changed greatly since Stephenson occupied this chair. His great work was so to improve the mechanical details of the steam locomotive that it became the practical proposition which revolutionised means of transport and did so much to advance the civilisation of the world. There have been many great changes in the modes of life of the world, but none has been so far-reaching and rapid as that of railway transport, and in no case has posterity singled out so unanimously the one man chiefly responsible for it. We do not, perhaps, realise as often as we should the difficulties that had to be surmounted in the mechanical engineering side of Stephenson's work, and it would be interesting if we could reconstruct the condition of mechanical engineering in those early days, so as to compare it with conditions at the present day. This is, however, not an easy matter when the diversity of our work is borne in mind.

Long before the foundation of our Institution, various astronomical and other instruments of intricate and beautiful design had been made, but the appliances in ordinary use eighty years ago were very simple, and from our present point of view crude. The general machine tools of the engineer's shop were few in number, although most of the simple types of machines which we use to-day had been invented and were being developed. It was, in fact, the period of the great pioneers of the machine tool industry. Only a few years before, Maudslay had died, and Clements lived until 1844. Working in the development of the industry were Nasmyth, Roberts, Fox of Derby, and the greatest of all these machinists, our Past-president, Joseph Whitworth, whose address in the eighth year of the Institution dealt with defects in iron, Bessemer's invention in steel manufacture, measurement and increased production. He will live in our memories not only as one to whom so many of us are personally indebted for his interest in education, but for those wonderful general-purpose lathes of such good workmanship and design that many of his age were to be found in jobbing engineering shops not many years ago. These, however, like the drills, planing machines, shaping machines, and slotting machines which had just come into practical use were simple in design and according to our present ideas of production slow in operation. Their slowness would probably impress us most, for they were dependent on cutting tools of plain carbon steel, and we should find the design restricted by the general use of wrought and cast iron.

Ideas we sometimes regard as new were passing through the minds of engineers in those early days. I will mention an example which is of particular interest at the present time. In 1848 Dr. Pole translated from the German Alban's book on a high-pressure boiler, which was, in fact, an interesting and early type of water-tube boiler. Alban held that boiler pressures should not be less than eight to ten atmospheres, and mentioned in an almost casual way that he had worked an engine with steam at a pressure of 1000 lb. per square inch. He said: "I firmly believe that these engines of great pressure would have produced good results." He found, however, that the steam generator was not perfect.

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I have always been impressed by the fact that George Stephenson seemed to be not only conversant with, but an expert on all that was known and of interest concerning mechanical engineering in his day. The present time is naturally one of specialisation, and even the ordinary course of three or four years at our universities only covers a small part of the theoretical knowledge of our profession. I have been much struck with this, for in the course I took in mechanical engineering at Mason College, Birmingham, in 1885–7, I attended classes in metallurgy, amongst other subjects, and had instilled into me an appreciation and devotion to this side of our work which I am thankful to say I have never lost. But I was impressed a few years ago by the fact that graduates with good honours degrees of various universities who came for their practical training to the works of which I have control, had little knowledge of metallurgy, which is surely one of the essential matters that should be understood by everyone who deals as we do with metals, their properties and the effect of heat and fluids on them. This is only one instance that shows how impossible it is at the present day to cover completely, even with intensive study, the many branches of knowledge of our profession. We are expected to have a working acquaintance with many sides of science which have a distinct and important bearing on our work, and we may therefore truly say that progress in mechanical engineering is and has been to a large extent dependent on advances made in various other sciences. It is on this interdependence of various sciences that I would now like to speak, and to endeavour to show how progress has been made thereby in the past eighty years, particularly in the materials we use.

Not because I am specially interested in the subject would I first of all like to speak of metallurgy, but because I think it will be agreed that it has probably played as great, if not a greater, part than any other in this development. It will be remembered that the growth of railways seemed likely to be held up about the year 1850 owing to the inability of the production of iron rails to cope with the demand, and I believe the same can be said of shipbuilding, the situation only being relieved when Bessemer invented his process of steel manufacture. At the time when the Rocket was being built, not only was there no large commercial production of metals and alloys of the quality and type which we look upon as commonplace to-day, but the actual production was, to our present-day ideas, infinitesimally small. Of the basic material, cast iron, the whole amount produced in the world in 1850 was only 4½ million tons; in 1926 this had grown to over 77 million tons. The amount of steel did not reach half a million tons per annum until 1870, whilst in 1926 it had reached over 90 million tons.

The Rocket was produced from ordinary cast and wrought iron and a small amount of brass. Compare this small number of metals with the varied and complex quantities used in the construction of such a simple machine as a locomotive to-day. We must remember that the constituents of the three metals mentioned were not then properly understood, nor yet subdivided as they are at the present day. Recently, I have been standardising the materials used on the 10,000 locomotives of the railway I am engaged on, and I find that it is necessary to provide specifications for thirty-two forged, wrought and cast steels, four wrought irons, three malleable and cast irons, twelve brasses and bronzes, and four other metals.

It may also interest some members to know that the British Engineering Standards Association, on the basis stated above, legislates for well over 100 different classes of steel. This number seems large, and many may think it unnecessarily so, but I feel that if the total be analysed, they will be found to be all necessary for the general and complex work covered, especially if the aim of using materials which will combine safety and efficiency with the least possible cost is borne in mind.

* * * *

Eighty years ago, as has been stated before, the world was approaching a crisis in the manufacture of iron and steel, and was about to enter what has been called the third great period of metallurgical progress, which was to help to change the civilisation of the world. In the first period, from primitive times to the fourteenth century, iron and steel had been produced by deoxidising the ore. This was followed by the indirect method of first producing a carbonised iron or cast iron, and then removing the superfluous carbon by somewhat tortuous methods at fairly low temperatures. Then came the Bessemer process in 1856, followed by the Siemens and Siemens-Martin processes, all dependent—like, in fact, Huntsman's production of steel in small quantities in a crucible—on a temperature which was sufficiently high to render the resulting product fluid enough to allow it to free itself from slag, &c.

It may be said that Bessemer was not in the full sense of the term a metallurgist, but he was undoubtedly a scientific man, and it was his capacity for using "ordered knowledge of natural phenomena and of the relation between them" that enabled him to get over his early difficulties. Siemens and the brothers Martin were metallurgists of standing, and it may be said that it was the work of these and other men at the same period which gave us that abundance of steel which once for all made the question of quantity one which need not be considered any longer. We are perhaps apt to forget that more than once in the history of industry the difficulties of actual supply have been a predominating factor in the progress of the world. Another well-known instance is that period in the middle of the eighteenth century, when the eating up of the forests reduced the production of charcoal, and so of iron. One can, however, safely say that the work done in the "Fifties" and "Sixties" of last century definitely removed all anxiety with regard to the supply of steel. The question of quality was, and is, however, a very different matter.

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The supply of materials was assured by the processes I have mentioned, and these were devised in a comparatively short time. But the improvements in those materials which have meant so much to us in providing lighter structures with increased safety, more durable metal, and the capacity for carrying out more work with greater satisfaction and in less time, have been of somewhat slow growth, and naturally have not reached finality yet. There are three of these improvements that I would like to touch upon, namely, the effect of heat-treatment on metals; the knowledge of their microstructure; and the introduction of steel and other alloys, which have provided and are still providing better materials. In the first two cases we have further instances of the interdependence of the sciences, for it has been the development of physics that has led to the progress that has been achieved.

The heat-treatment of steel undoubtedly started

when by accident some early and primitive steel worker found that the quenching of the hot mass he had produced gave it a hardness that was probably at first a problem and a trouble to him, and afterwards of the greatest value to engineers. The effects of simple treatment were known to our first President, but it was not until the pyrometer came into more general use that we were able, by its aid, together with that of micrography and macrography, to get absolutely reliable information with regard to the steels produced. One should, however, never forget the pioneer work done by scientists, which has led to what is now our everyday practice in the treatment of materials. It would be impossible to name all of those to whom engineers are indebted, but one cannot pass on without mentioning Sorby, Osmond, Roberts-Austen, and Le Chatelier, amongst the number who come to one's mind. I have already said that it may be thought that I am giving a too special prominence to metallurgy, but the very platform from which I am speaking is the most historical spot in existence in connection with the co-operation of engineering and metallurgy.

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The question of metallography is so closely associated with the heat-treatment which the metals receive that it is very difficult to separate them. It is, of course, owing to the possibility of examining the structure of metals under the microscope that we have been able to follow so closely the effect of heat-treatment upon them. Here we have to thank Dr. Sorby, the geologist, who in 1863 turned from the examination of geological specimens to an investigation of the structure of metals. In 1886 and 1887 he read his papers on "The Microscopical Structure of Iron and Steel," before the Iron and Steel Institute, in which he showed the true structure of pearlite, and since that date the study and examination of metals through the microscope has become an everyday part of the work of the metallurgist. As the work of Whitworth has given us means of close and accurate measurement, so the work of Sorby of Sheffield has given us means of determining closely and accurately the heat-treatment any particular steel has received.

Work is still progressing in this direction. Some time ago Dr. Rosenhain worked on the use of ultra-violet rays in connection with metallography with high magnifications. Recently I have seen some very remarkable photo-micrographs of steel taken in this way at a magnification of 3500 on to the lantern plate. The picture on the screen represented an area of steel having a diameter of under 0·0017in., or about one six-hundredth of an inch.

* * * *

The question of alloy, or special steels, is a very large one, and I can only touch briefly on it and its important bearing on mechanical engineering. In reality, all steel comes under the category of alloy steel, but general usage confines the term to steels containing a specially added substance other than carbon.

As far back as 1821, Faraday published a work on "Alloys of Steel," and experimented with allloys both of nickel and chrome, but neither he nor Berthier, who worked shortly afterwards in France on similar lines, carried the work into the industrial world. The same may generally be said of a group of experimenters who worked both in Europe and America in the late "Sixties" and early "Seventies" of last century. One exception is the work of the Mushets, who about 1857 brought out their self-hardening tool steel, with tungsten as the essential alloying metal. Even this was not followed up, and it was not until many years afterwards that the work of White in America, about 1900, showed that by increasing the amount of tungsten and chromium, steel would not soften at high temperatures, and thus cutting speeds could be multiplied many times. It is a well-known fact that this led to almost wholesale scrapping of machines, as no longer was the tool the weak link in the production chain, but the design of the machine itself. Various improvements in tool steel have taken place since that time, especially with a view to ascertaining the best alloys for special purposes.

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It has often been said, and with every truth, that the alloys of steel, notably those with chromium and nickel, have made possible the mechanical revolution which has taken place through the autocar and the aeroplane. There is now no difficulty in obtaining steels with a tenacity of over 100 tons per square inch with an elongation of 9 per cent. on 2in. Our only difficulty is to decide when it is advantageous to use these from a commercial standpoint. Advance has also been made in higher carbon steels with high yield-points for shipbuilding and other purposes. Undoubtedly we shall before long be considering the use of such steels, or else of nickel and other alloy steels, for boilers, since we have pressures up to 3200 lb. per square inch in use for stationary boilers, and up to 1400 lb. per square inch in locomotive practice. In the latter case a 3 per cent. nickel-steel is actually being used. There has been in the last few years a great advance in the use of chromium as an alloy of steel, although, as I have mentioned, Faraday and Berthier experimented in this direction over 100 years ago. We naturally appreciate the non-oxidising advantages of this material, but the price prevents its general commercial employment, notwithstanding the fact that its uses for special purposes are growing rapidly. Its capability of resisting high temperatures has made it indispensable for valves in many internal combustion engines.

* * * *

A consideration of non-ferrous metals at once shows that an ever-increasing range of metals and their alloys has become available for our use. At the period I have taken as a basis, the work of Muntz was already known, but it was much later before full advantage was taken of the properties of the brass which goes by his name. In those days when articles were produced in small quantities, the property of a brass which could be easily hot worked had not the commercial advantage it had when production became greater. Now the most intricate forms of stampings and complicated extruded sections are available when we wish to use them for mass production. The use of non-ferrous alloys of this and similar types was for long retarded because in the majority of cases, although being practically non-corrosive, their strength was less than that of ferrous materials. The advance which has been made in this direction, however, can be best shown by quoting the British Engineering Standards Association specification No. 208, 1924, for high-tensile brass castings, which calls for a tensile strength of 45 tons per square inch with 12 per cent. elongation, and for high-tensile brass bars which requires 28 tons per square inch with 25 per cent. elongation on a gauge length not less than four times the diameter. Even higher figures of tensile strength or elongation are available, and a whole range of different alloys comes into this class which includes the so-called "manganese-bronze." Progress here, if slow, has finally been great.

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Aluminium was not known commercially until about thirty-five years ago, and even in 1913 the world's production was only 64,000 tons. In 1926, however, this had risen to 235,000 tons, or 3·67 times as much. Although in its pure state it is not generally satisfactory for our work, when alloyed with small proportions of other metals it is becoming invaluable. The ninth, tenth and eleventh reports of our Alloys Research Committee did much to show what wonderful properties can be obtained from these alloys to meet various requirements. The work of the Light Alloy Sub-committee of the Aeronautical Advisory Committee, in conjunction with these reports, shows what a wide range of requirements can be covered. One should perhaps specially refer to the monumental eleventh report of our Alloys Research Committee, which is one of the most complete and exhaustive research reports ever published. The qualities of the "Y" alloy which Dr. Rosenhain described there, and of duralumin have placed entirely new materials at our disposal. It seems somewhat surprising that the chief use of these new materials is so far practically confined to aeronautical purposes and for certain parts of motor car work, although they have been known for so long, and in the case of the smaller internal combustion high-speed engine have become universally employed for pistons. They can be used either as castings or forgings.

* * * *

There are certain purposes in our work for which a metal which will resist oxidisation at high temperatures is advantageous. In the last few years much investigation has taken place in this direction. We now have certain alloys of chromium and nickel which are fairly easily cast and have this property to a marked degree. They are extremely useful for case-hardened pots and other articles subjected to an oxidising flame. Their only disadvantage is that at present their first cost seems high, and for articles which have to be replaced the dictum of a friend—the head of a large industrial research laboratory—that "quality is remembered long after cost has been forgotten" does not always hold good. In addition to their use in castings these two metals in various percentages and combined in the former with copper and in the latter with chromium and iron can be rolled and forged and should come into increasing use. One should also mention the "natural" alloy of copper and nickel called after the late Colonel Monel. This was one of the first of this type of non-ferrous alloys put to practical use.

Nickel by itself, in which Canada is so particularly interested, has not many uses at present. It is, however, not only being used for plating, but to an increasing extent for deposition. New knowledge has enabled us to produce deposits of very great hardness which allow of the successful building up of worn parts, and this is especially useful in the smaller internal combustion engines used in automobile and aeronautical work.

There are also certain metals which we have been in the habit of looking upon as rare, or semi-rare, which are now coming into use for our work. Of these, perhaps the most important is magnesium, which gives us an additional base for another series of most interesting light alloys. At present it is practically unknown in this country. During the war experiments were made with this metal as a constituent of light alloys, but these did not give the results hoped for. It is, however, only of recent years that the manufacture of this metal has taken place on such a scale as to allow it to be produced at a commercial price. In Germany great progress has been made in the last few years in alloys in which the proportion of magnesium is in the neighbourhood of 90 per cent. It may be pointed out that whilst the specific gravity of aluminium is 2·67, that of magnesium is only 1·74, and therefore we have at our service a metal which is even lighter than what we have been accustomed to look on as our lightest material, and which I am afraid has been looked upon in the past for this very reason with unwarranted suspicion. I think that aluminium has for long suffered from this, and from having been pushed forward in early days as a pure metal for purposes for which it was not suitable. The knowledge we now have should prevent magnesium from being prejudiced in this way. In Germany, where the production and use of magnesium alloys has been developed, they are being largely used in place of aluminium alloys for pistons and other parts of motor cars. They have the advantages of being extremely easy to machine, they can be readily forged and extruded, and recent developments have provided alloys of greatly improved strength compared with any magnesium alloys hitherto available, both in the cast and worked conditions.

Cadmium has a great advantage as a metal to be used for plating, for it possesses high corrosion-resisting properties. It is also valuable for use as an alloy of copper in telephone wires, and for overhead conductors for tramways, where it adds considerably to the resistance to wear and has also good electrical conductivity. Cadmium is also coming into use for solders, and as a constituent of bearing metals. Its availability for industrial application is clearly indicated by its price, which at present is considerably lower than that of tin.

I have already referred to the advantage of chromium in alloy with iron and nickel. When used for plating it also gives greater resistance to an oxidising flame, and is finding applications in industrial plant quite beyond the ordinary plating field.

Cobalt, tungsten, vanadium, and molybdenum are chiefly used as alloys of steel, but it may be that before long they will be available for special uses in a basic form, and, in fact, tungsten is used in electric lamps at the present time.

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I have endeavoured to show that the progress we have made during the past eighty years is largely due to work not directly connected with our own daily duties. Research will undoubtedly give us information which will allow our progress to continue, if not always as quickly as we would desire. It is therefore incumbent upon us to take advantage of the assistance at hand as quickly as possible. In the past this has not always been done. This may be due to the necessity of considering immediate commercial results, which may sometimes make us impatient with research. We make the mistake of expecting results similar to those from our machines, forgetting that mechanical production follows well-known laws long tried out. The research worker is the pioneer, often working in practically unknown lands, and with little to guide him, and I think he must himself frequently be discouraged by not making the progress he desires. He is the explorer finding the path along which we may progress.

It has been said that the training of an engineer is one which tends to dull or blunt the imagination. This may or may not be true, but the assistance we receive from those not directly connected with engineering will always be great. It lies with us to use to the fullest extent the tools which they forge for us and the knowledge they place at our disposal. Their work must always differ from ours, and, appreciating this, we must for our own sakes give what assistance we can. We are chiefly concerned with design, production, and output, and once having settled our course of action, we push forward on a definite path. The research worker must constantly be considering the next step he is to take.

Erecting Cranes for the Sydney Harbour Bridge.

The bridge now being erected across Sydney Harbour, New South Wales, by Dorman, Long and Co., Ltd., Middlesbrough, is designed to accommodate four railway tracks, and, in addition, roads and footways aggregating 80ft. in width. The principal feature of the design* is an arch 1650ft. in span and of a total width of 150ft. The height to the top of the arch is 450ft. The decking suspended from it will allow at high water a head room of 170ft. for vessels passing into or out of the harbour. The arch springs from decorative granite abutment towers on each side of the harbour. With the approach spans, the bridge will have a total length of 3770ft. The bridge is by far the largest arch bridge in the world, the nearest to it in size having an arch span of about 1000ft.

The construction of the arch is to proceed simultaneously from the two shores of the harbour until the halves meet at the middle of the span. In the accompanying engravings and in our two-page

* For an illustration of the bridge as it will appear when completed see our issue of March 7th, 1924.

ERECTING CRANES FOR SYDNEY HARBOUR BRIDGE

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION LTD., LONDON AND DARLASTON, ENGINEERS

CRANE EQUIPMENT AS ERECTED FOR TRIAL

2½ TON DERRICK CRANES ON MAIN TRAVERSING CARRIAGE

Supplement we illustrate the crane equipment which is to be used for placing the sections of the arch in position. This crane equipment has been made in duplicate in order to meet the requirement of erecting the arch in two parts simultaneously. The crane equipments have been designed and made by the Wellman Smith Owen Engineering Corporation, Ltd., of London and Darlaston, except as regards the structural work, the fabrication of which was undertaken by Messrs. Dorman, Long. Each equipment has a total weight of 600 tons, to which must be added in each case 33 tons, the weight of the safety gear with which each, as will presently be explained, is provided.

Each equipment consists of a structural undercarriage extending across the top booms of the arch and carrying a self-contained crane unit. This crane unit is capable of being traversed across the undercarriage and can therefore be made to serve the whole width of the bridge. The undercarriage is hauled outwards along the booms as the erection proceeds, so that, in effect, the equipment is made to lay its own track. The material for the bridge is hoisted by the equipment from the water surface below.

The undercarriage consists of a double cantilever structure mounted on four bogies which travel on the two outer top main booms of the arch. Each bogie has four unflanged wheels. The front bogies have horizontal guide rollers bearing against the side flanges of the boom. The bogie wheels run directly on the bridge booms as a track. Safety clips are fitted to each bogie to prevent any possibility of the structure tilting. The front bogies are fitted with a jacking arrangement so that the whole structure may be lifted off a set of keep plates attached to the boom in advance of the crane. These keep plates, in addition to acting as stops for the crane equipment, have incorporated in them the anchorage for the haulage ropes. When the undercarriage has been hauled to a new position the jack gear is released to lower the structure on to the keep plates, which then take the load off the haulage ropes.

The hauling gear consists of a double drum winch driven by a single motor, and is situated at the middle rear of the undercarriage, as shown in one of our illustrations. The motor for this gear is of 50 H.P., and the hauling speed is 1ft. per minute. The winch is arranged with ratchet and clutch gear, in order that one barrel may be operated independently while the other is held in position. The ropes from the drums pass to the anchor on the bridge boom through an 8 to 1 sheave gear. In order to ensure the crane equipment advancing truly in the line of the bridge, the standing ends of the rope are attached to a limit switch, which is so arranged that should one side become slightly in advance of the other, the limit switch comes into operation and stops the motor. When this event happens the barrels can be operated independently and the crane relined before proceeding on its travel up the bridge. In view of the possible serious consequences of any mishap to the haulage gear special attention has been given to the provision of safety gear designed by Mr. Ralph Freeman, M. Inst. C.E., consulting engineer to Messrs. Dorman Long. In case of failure of the haulage ropes the crane will be retained in position by means of two heavy link-and-pin drag chains connected to the front of the undercarriage and passing over sprocket wheels solidly attached to a worm gear operated by a constant torque electric winch by which the chains are kept constantly in tension but are not used for the actual haulage.

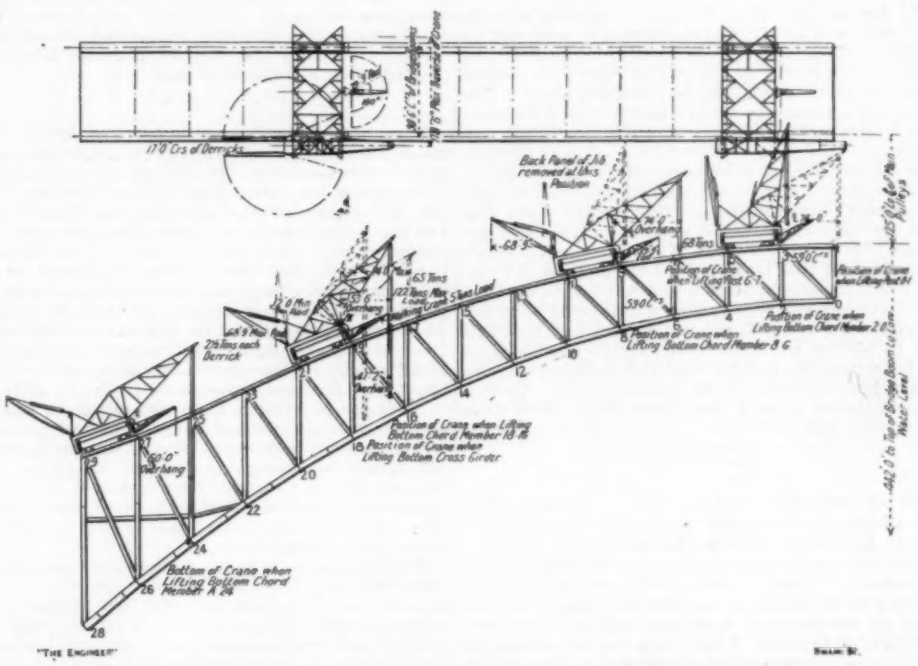

17'0" C's of Derricks
Back Panel of Jib removed at this Position
60'0" Overhang
65 Tons
68 Tons
2½ tons each Derrick
Position of Crane when Lifting Bottom Chord Member 13 R
Position of Crane when Lifting Bottom Cross Girder
Position of Crane when Lifting Bottom Chord Member 8 G
Position of Crane when Lifting Bottom Chord Member 2 C
Bottom of Crane when Lifting Bottom Chord Member A 24
"THE ENGINEER"

DIAGRAM OF CRANE EQUIPMENT AT VARIOUS STAGES OF THE BRIDGE CONSTRUCTION

On the undercarriage is mounted a main jib crane which can be traversed across the width of the bridge. An A frame is mounted on the traverse carriage, carrying at its apex the anchor pins for the jib derricking screws and the operating gear. The main hoist will lift 122 tons through a height of 480ft., and is operated by two 120 H.P. series-wound motors. The main hoist is to be used for lifting the bridge members from the harbour, but on the lower boom of the jib there is a track for a "jigger" hoist, which will be used for canting the bridge members into their exact position for final attachment.

The main hoisting winch is provided with two drums and clutch gear, and two motors are fitted. These drums can be operated together or independently. Each winch is capable of hoisting a load of 65 tons at a speed of 12½ft. per minute or, alternatively, 33 tons at 25ft. per minute. The hoist blocks are coupled by a lifting beam, which takes a maximum load of 122 tons. The jigger hoist is operated by a single motor winch, situated in front of the main hoisting gear, and is capable of lifting a load of 20 tons at 25ft. per minute. This motion is fitted with a two-speed gear, which enables varying loads to be lifted at 12½ft. per minute. As both the main and the jigger hoists may have to work together to bring the chords of the main booms up to a predetermined angle, indicator gears have been fitted, so that the driver can see the exact position of the snatch blocks relatively to each other. By means of this indicator gear he is also able to adjust the members as they are being fitted into position. The hoisting rope of the

jigger passes over a pulley arranged near the outboard end of the main jib, and over a trolley running on a track situated down the centre of the bottom boom of the main jib. This trolley is adjusted to the radius required by means of a winch operated by a 50 H.P. motor. The rope supporting the trolley is also taken over a pulley attached to the outer end of the jib and anchored to the moving trolley.

The jib is derricked by two 50 H.P. motors operating through spur and bevel reduction gearing on to nuts which engage with two derricking tension screws. Derricking can be done throughout the full range under full load in five minutes. The derricking screws are 9in. in diameter, and the nuts pivoted to the jib are of phosphor bronze. It will be seen from the accompanying diagram showing the position of the crane equipment at various stages in the erection of the arch, that the angle of the whole crane varies as it proceeds up the booms. The variation in the angle is from a maximum of 24 deg. at the bottom to almost horizontal on the last chords. This variation of tilt necessitates making an alteration to the jib when the crane is nearing the top in order to derrick into the minimum distance required. This alteration consists of taking out one of the diagonal members of the last panel of the jib and moving the position of the nut pivots to the first apex of the diagonal bracing. This alteration is illustrated in the diagram.

The cross traverse gear is operated by a 50 H.P. motor driving, through worm and bevel gearing, on to toothed wheels which engage with a rack extending the full length of the travel along the undercarriage. This gear is capable of cross traversing the crane equipment at a speed of 5½ft. per minute. In order to avoid shock, the gear is fitted with special switches which automatically reduce the speed when the crane approaches to within 10ft. of either end of the undercarriage.

Since the crane is set at an angle, ordinary flanged wheels would be unsuitable for taking the thrust caused by the sliding action. Consequently, provision has been made to accommodate the load across the track by means of a special girder carrying large thrust rollers attached to the top boom of the front undercarriage girder.

A frame attached to the traversing carriage contains two 2½-ton derrick cranes, which will be used for handling material and tools, and placing men in position for bolting and riveting up the work. This frame can be adjusted to the angle at which the crane is working so as to ensure that the masts will always be vertical. Were this adjustment not provided, the slewing motion would be interfered with. These two cranes are shown in one of our half-tone engravings, but are omitted in the Supplement. They are driven by a single 10 H.P. motor and the various motions are controlled through clutch gearing. The arrangement of these cranes is such that they can be swung completely round in order to transfer material from the back to the front of the crane system, where it can again be handled by an independent travelling jib crane running on tracks provided on the front main girder of the undercarriage. This crane will be used to handle material, tools and workmen, while the chords are being fixed in position. It will be seen from the illustrations that it is independent of the main crane above it, and can move to any position as required. It is fitted with three motions—hoisting, traversing and slewing. The hoisting gear is operated by a 30 H.P. motor driving a drum through spur gearing, and is capable of lifting 5 tons at 60ft. per minute through a distance of 480ft. The cross traverse gear has a 10 H.P. motor driving the axles through worm, spur and bevel gearing, and is capable of giving a travelling speed of 50ft. per minute. The slewing gear has a motor driving, through spur and bevel gearing, on to a large bevel wheel attached to the bottom of the king post. Provision has to be made for the adjustment of this crane, and consequently its king post and jib structure are mounted on a pivot. Adjustable tying gear is attached to the top of the king post and carried back to "kick" rollers running on the top track on the front girder of the undercarriage. Kick rollers are also provided at the bottom of the main carriage front girder to accommodate the thrust loading.

The electrical equipment of the crane system

DRAG CHAIN SAFETY GEAR

possesses several features of interest and importance. The incoming supply is taken through a double-pole circuit breaker with a no-volt release to an ironclad distribution switchboard on the undercarriage structure. Loads are taken from this board to live rails provided to supply current to the traversing portion of the crane system, to trolley wires for the 5-ton independent jib crane, to the control gears for the motors on the undercarriage and to the auxiliary derrick cranes. On the traversing portion another distribution switchboard is fixed, from which leads are taken to the control equipment for the various motors associated with this unit. For all the motions the control gear is of the contactor type. The contactor panel and resistances are placed near the motor to be controlled, and the motor controllers are grouped in a central control position. A platform is provided to accommodate the controllers for the motors on the undercarriage and a cabin for the controllers of the motors on the traversing portion. Each contactor panel is self-contained and is provided with overload and no-volt protection, the actual scheme of control being suited to the particular motor to which it is applied.

The motors and their control schemes are as follows:—

Main Haul.—A series motor with an electric brake on the lowering side.

Jacking Motors.—Two 25 horse-power series motors, with plain series control. There is a separate panel of the controller for each motor and the controllers are mechanically coupled.

Main Hoist.—Two 120 horse-power series motors, each with an independent master controller and contactor panels. The master controllers are mechanically coupled, but can be operated independently when required. The control scheme is of the plain series type with electric braking on the lowering side.

Jigger Hoist.—One 50 horse-power series motor, with a control scheme similar to that of the main hoist motors.

Derricking Motion.—Two 50 horse-power compound-wound motors, each with its own contactor panel. The two master controllers are mechanically coupled. The panels allow plain series control with two slow speeds in each direction.

Jigger Traverse.—One 50 horse-power series motor, with a control equipment similar to that on the main hoist.

Traverse of Crane.—One 50 horse-power series motor, with control equipment giving plain series control with notches for slow speed in each direction.

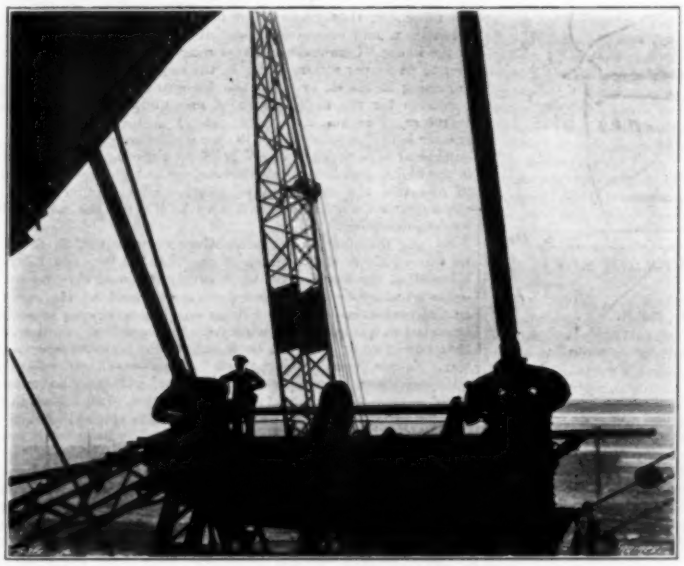
Limit switches are provided on the main and jigger hoist motors and on the main traverse, jigger traverse, jacking and derricking motors. On the hoisting motions these switches limit the travel in the hoisting direction only. On the other motors they limit the travel in both directions. All the switches are of the shunt type, and are arranged to open the control circuit at the contactor panel concerned, and so cause all the contacts to open and cut off the current supply to the motor. All the motors are fitted with solenoid brakes, which are arranged to come into action and bring the motor to rest as soon as the current is shut off.

The 5-ton auxiliary crane is an independent unit and takes its current from the trolley wires on the undercarriage. Its hoisting motion is operated by a 30 horse-power series motor controlled by a contactor panel which gives a plain series control for hoisting and electric braking for lowering. Its slewing motion is operated by a 5 horse-power series motor with a drum controller, giving plain series control in both directions. The travelling motion is derived from a 10 horse-power series motor with a similar type of drum controller. Overload and no-volt protection is provided by a magnetic circuit breaker panel common to all three motors, a relay being provided for each individual motor. Shunt brakes are fitted on all three motors. A limit switch operating in the hoisting direction is provided for the hoisting motor, and one operating in both directions for the slewing motor.

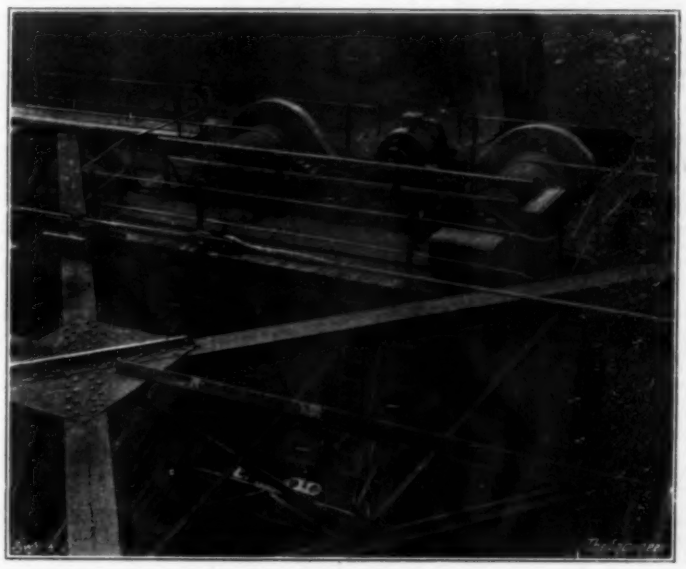
The 2½-ton derrick cranes are each driven by a single 10 horse-power series motor from which all the motions are obtained by clutch gear. The motor of each crane is controlled by a drum type controller. Protection is afforded by a magnetic circuit breaker and limit switches operating in conjunction with the circuit breaker are fitted to all motions.

All the electric controllers on which the safe and efficient operation of the whole equipment so largely depends were supplied by Allen West and Co., Ltd., of Brighton.

On page 484 we reproduce a photograph of the complete crane equipment as erected for trial in Messrs. Dorman Long's yard at Middlesbrough.



DERRICKING GEAR OF MAIN JIB



HAULING WINCH FOR UNDERCARRIAGE

RAILWAY ELECTRIFICATION.—It appears that in the advance proof of Mr. Roger T. Smith's Opening Address delivered before the Institute of Transport on October 10th, an error occurred in the transcription of the figures given for the cost of electrifying an English main line. This error was repeated in our note on Mr. Smith's address which appeared in our Seven-day Journal page in our issue of October 14th. The estimated capital cost per route mile of double track, exclusive of power stations and long transmision lines, was given at £25,000 for suburban lines and at £60,000 for main lines. The latter figure should, we are now informed, have been £6000.

H

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RECENT BRITISH LOCOMOTIVES.

Sir,—Some twenty years ago at the Institution of Mechnical Engineers Mr. Ivatt—G.N.R.—said in effect: "If you cut off earlier you will consume more steam and coal, as we have proved in practice, although I cannot here develop the scientific explanation of it." A page of Diesel-like steam cards from locomotives illustrated the subject.

The explanation has since then been provided graphically by the pressure indicator with locomotives specially running down grade without any steam in order to measure the negative horse-powers indicated at the various cut-offs and speeds, and which in the ordinary way appear in the form of compressions when the engines are doing positive work under steam. With short cut-offs the negative horse-power is very high, and augments in *pro rata* with increased speeds, as is strikingly shown by these steamless indicator cards; so that, at a less cut-off than 33 per cent. in steam working the theoretical advantage of the longer expansions is cancelled out by the curve of negative horse-powers; consequently, the curve of steam consumptions rises rapidly, as from 30 down to 20 per cent. cut-offs, while the curve rises only gradually from 35 to 45 per cent., and at 50 per cent. cut-off the steam consumption per unit of power in single expansion has been shown by numerous dynamometer tests of the most powerful locomotives in the world to be less than it is at 20 per cent. The higher the speeds the greater become the negative horse-powers indicated, and therefore the necessity to increase the cut-offs, in order to maintain any given M.E.P. and indicated tractive effort. This appears in the new steam tables of M.E.P. by Charles R. King. For example, to maintain a constant M.E.P. of 59 lb. per square inch, in per cent. of the boiler pressure, from a starting cut-off of, say, 40 per cent., the cut-off must be gradually advanced to 45 per cent. at 90 r.p.m., to 50 per cent. at 127 r.p.m., to 55 per cent. at 160 r.p.m., to 60 per cent. at 180 r.p.m., and to 70 per cent. at 200 r.p.m., as shown by the pressure indicator, and with the result that the combined effects of compressions and wire-drawing (= attenuations) caused by increasing speeds are exactly countered by the increased cut-offs as here stated. This can be verified by all by direct reference to indicator cards.

Practical working experience, as revealed by the pressure indicator, is thus now reduced to a science available by all practical workers; but this new knowledge entails the "scrapping" of the bulk of those old text-books and treatises on steam in which are published that old fallacy which for a century has led engineers to suppose that by reducing the cut-offs down to, say, 1 per cent. of the stroke, the economy in actual working will increase proportionately. Modern experience, on the contrary, has shown that in every class of steam engine, and even in explosion engines, the consumptions augment to maximum at the low-torque end of the curve.

The short cut-off is particularly wasteful of the motive power fluid, because with large journals or bearings and large crank pins the consumption in the cylinder and in the clearances is extremely high in relation to the low practical turning effort on the crank shaft; but, oppositely, the more that the cut-off point is removed from the dead end and from low tangential angles, the greater becomes the effective output in per cent. of the consumption. During dynamometer tests covering many months of work with all classes of locomotive, and in particular regard to the new ones using superheated steam, these facts were first recognised on the Italian State Railways in 1908–9, and the results, shortly afterwards tabulated, were communicated to the Engineering Press by the present writer, since which time railways throughout the world have confirmed these same facts in regular working practice. Working practice and the text-books on steam engineering are now proved to be as wide apart as the poles as regards the rule concerning steam expansions, and in this respect the books are an actual hindrance to true conceptions of the subject, and an effective delay to progress.

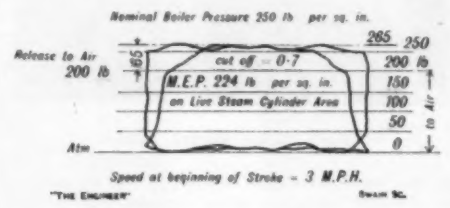
For close on forty years various inventors have secured the adoption of some of the most perfect forms of trip gear—*e.g.*, Bonnefond—applied to locomotives, and which have given cards as ideal as those from the best, slow-speed, trip-gear stationary engines, and almost without compressions at cut-offs down to 5 per cent. But power applied at the dead centres of the crank has never proved to be of much use in railway locomotives, so that, although these gears were applied and operated during a very great number of years on both simple and compound locotives, the gain at the normal working cut-offs was so slight that eventually one after another these admirable gears, favouring short cut-offs, have been abandoned. (Revived on English railways, for simples, the steam consumption per d-b.H.P. hour is 32 lb.) Extra long valve travels, as used in P.L.M. Railway compounds and in G.W.R. simples, attain practically the same end; while, fifty years ago Loftus Perkins so arranged the valve settings that compressions were eliminated even still more than by ideally perfect trip gears. In the G.W.R. "Castle" class engines, with the lowest practicable cut-offs for locomotives, the minimum consumptions—for an average throughout I.H.P. of 1114, Swindon–Plymouth–Swindon—was 20·9 lb. net steam per I.H.P. hour; on the other hand, with cut-offs of 42 per cent., rising to 70 per cent. on the steeper gradients, the consumption during entirely up-hill running with an express train of 487 tons, and requiring about 1900 I.H.P. average, may be as low as 9·36 kilos. = 20·5 lb. water per I.H.P. hour. For actual road working up-gradient this is perhaps the most economical performance known, and of which the most complete figures are available for counter-checking the results obtained, and is briefly summarised on the line "J," page 509, June 8th, 1917.

A fact not generally remembered is that in 1909 the six-coupled saturated steam compounds of the P.L.M. consumed only 20 lb. steam per I.H.P. hour hauling loads 461 tons at 50 m.p.h., Laroche–Blaisy.*

During thirty-five years that I have closely followed practical working dynamometer tests of the newest systems of locomotives in continental countries, I have often had occasion to urge on drivers, of both simple and compound locomotives, the practice of more rational methods of working the expansions, more especially so with their simple engines than with the compounds, since the latter have invariably been so greatly under-cylindered that drivers had no alternative but to give wastefully long cut-offs to get the available steam through. But, where the profiles were fairly level, the short, uneconomic cut-offs in compounds were favoured by drivers. In England, for example, I found 30 per cent. H.P. + 60 per cent. L.P. was used, with notoriously bad results—as in all countries where double reversing gears are used—and it was apparent to me then, in 1910, that drivers would not heed my recommendation to cut-off steam at 40 per cent. in both groups, H.P. and L.P., and to throttle down with the regulator. In Italy drivers were unwilling also; so to avoid these bad results, of which everyone has heard, the cure has appeared to almost all continental railways to use only one valve for each brace of cylinders, or, otherwise, to fix the valves so as to give equal cut-offs—except only at very high speeds, where the indicated tonnage on the L.P. piston has to be balanced co-equal with the H.P. tonnage by means of a slightly earlier L.P. cut-off (Austrian and Bavarian practice). Maximum card areas and horse-powers are thus ensured, beyond the power of drivers to alter the pre-determined conditions.

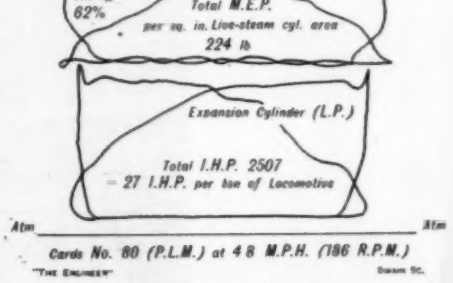
With all esteem for the suggestions offered by Mr. Rickie, I can assure him, from exceptionally wide experience, that the moderate steam consumptions recorded on page 577, May 31st, 1912, with the new S 10^3 Prussian State compound engines, with 580-ton express trains—that is, 12·4 lb. steam per I.H.P. hour and 17·8 lb. steam per horse-power hour at the drawbar—would be impossible with the short cut-off of 20 per cent. indicated by him. It is a proved mistake—see col. 3, page 393, October 23rd, 1903.

With saturated steam, however, the cut-offs were formerly lower than with superheated steam now, because the initial losses of temperature + volume + pressure were less, as is proved by hundreds of series of indicator cards; and cut-offs of 35 per cent. in the saturated steam, 75-ton compounds of the Portuguese State Railways gave 2082 H.P.; while 50 per cent. cut-offs indicated 2246 I.H.P., or 30 I.H.P. per ton of loaded locomotive—a record. But the pressure indicator shows that, with superheated steam, very full cards can only be obtained by longer cut-offs because the B.Th.U. in each cubic foot of steam is less, and its specific internal energy is 20 per cent. lower. Modern experience proves the necessity of long simple cut-offs—35 to 45 per cent.—with superheated steam, so as to obtain



"SIMPLE" AT 3 M.P.H.

M.E.P. 224 ÷ 265 = 85% of max. cyl. press. at 70% cut off, when starting train.


Actual Boiler Pressure = 220 lb per sq. in.
cut off = 0·7
211 lb per sq. in. initial P.
211 lb initial
Cut off 62%
Total M.E.P. per sq. in. Live-steam cyl. area 224 lb
Expansion Cylinder (L.P.)
Total I.H.P. 2507 = 27 I.H.P. per ton of Locomotive
Atm
Atm
Cards No. 80 (P.L.M.) at 48 M.P.H. (186 R.P.M.)
"The Engineer"

COMPOUND AT 48 M.P.H.

M.E.P. 224 ÷ 220 = 101% of boiler P. at 70% cut off with 11 lb. higher pressure than exhausted by "simple" to air.

the highest thermal efficiencies. While this experience has been reported in many elaborate articles dealing analytically with the subject in Italian and French periodicals, in this country, on the contrary, diplomaed writers on steam locomotives still adhere to the century-old theories of the text-books on steam engines—unlimited expansions in one cylinder—and the antagonism to the modern experience is sufficiently evident in the attitude of such contributors in the railway papers, who prefer now to advise the use of turbines with condensers in order to realise the 13 per cent. thermal efficiency which is already obtained by compound engines without condensers; but which would advance to 16 per cent. with the efficient condensers borrowed from turbine locomotives.

The pressure indicator now shows that at all speeds and at all economic cut-offs, the second expansion of that steam which is now hourly thrown to waste in simple engines, adds 50 per cent. to the indicated power of locomotives, and has done so since 1876, when the first low-pressure tank compounds were tested by the Paris-Orleans Railways.

Thus, the latest cards from simple-expansion engines, with boiler pressures of 250 lb. to 265 lb. show M.E.P. (in starting) = 85 per cent. of the boiler pressure, the steam being released to the chimney at 200 lb. per square inch. But starting with 211 lb. per square inch—only 11 lb. above the release pressure in the modern simples—compound engines indicate 2507 I.H.P. with a similar cut-off (= 70 per cent.), but running at 186 r.p.m. or 48 m.p.h., and with a mean effective pressure indicated of 101 per cent. of the boiler pressure, or 101 − 85 ÷ 85 = 18 per cent. greater than the maximum attainable in single expansion when first starting trains and with 200 lb. per square inch released into the chimney. The steam in the latter only drops 65 lb. per square inch before release to the air.

The compound cards referred to are numbered "80" and were taken from compound engine No. 6204, July 9th and 10th, 1913, while hauling express trains of 645 tons (of over a quarter of a mile in length) from Laroche to the summit of the line at Blaisy, ascending a net altitude rise of 1060ft. at average speeds of 50 to 55 m.p.h.—on different days—with steam at an average of 219 lb. per square inch, supplied to (only) two outside cylinders 17½in. by 25·5in.—similar to dimensions common in Britain sixty years ago—on a throughout up-hill consumption of 13·5 lb. water per I.H.P. hour, with an average of 2425 I.H.P. for 20 miles up the steepest inclination of 1 in 125—that is, 2425 ÷ 90 = about 27 I.H.P. average per ton of loaded engine. In starting with its express train load of 645 tons, in coaches, the auto-speed indicator has traced an acceleration curve almost similar to that made by the simple superheated steam "Pacifics," with four 19in. by 25·5in. cylinders, while hauling 487·5 tons—see page 510, June 8th, 1917, and also Supplement, December 14th, 1917. The original, as also the indicator cards, may be seen by anyone in doubt—as seems a certain Mr. Keller, who appears to have seen the cards "No. 80," reproduced in some London magazine as an illustration of this fact that, with equal cut-offs, and equal consumptions per revolution, the tonnage indicated on compound pistons at 186 r.p.m. (48 m.p.h.) is 18 per cent. greater than the maximum that is indicated when simple engines are just beginning to move. The cut-offs are 70 per cent. H.P. and 62 per cent. L.P. The correspondent named quotes "70 per cent. and 40 per cent.," and implies that the cards No. 80 were made when just starting. They were made on the bank of 1 : 125 with a 645-ton train, a quarter-mile in length, at 48 m.p.h.

October 24th. Charles R. King.

Sir,—It is questionable if the North-Eastern and Great Western four-cylinder locomotives and the L.M.S. three-cylinder locomotives, as presently designed for the respective routes on which they are operated, could operate so well on the routes for which the others were designed. That of the L.M.S. Company was designed to mount Shap and Beattock summits, either on the northern or southern run, with the train loads that they have to carry; and while their full tractive power is required for these two parts of the route, it must be the case that during other parts they can operate with a steam pressure of 200 lb. per square inch, if not less. It would be interesting to know what the boiler pressure per square inch is when Shap and Beattock have been surmounted.

I consider that if the cylinders of these three types of locomotives are to be compounded with the object of effecting economy of coal consumption, with the present tractive power that can be developed, other features of the designs than those of the dimensions of the high and low-pressure cylinders will have to be given prominence in the first instance, and have to be proved to be feasible, before the compounding of the cylinders can be admitted to be a possibility in the cases of the coal-fired steam locomotives under discussion. Expressing that statement in other words, I believe that it is impossible to effect the compounding of the cylinders of the present-day locomotives for the respective routes for which they are designed, with the object of attaining greater economy.

The reasons that present themselves to my mind for holding that belief are as follows:—First, that it is necessary, in the case of express train locomotives, to provide means for effecting in the smoke-box suction equivalent to 9in. of water gauge for maintaining the suction of the gases of combustion in the fire tubes of the boiler that will maintain the rate of combustion of the coal per square foot of fire-grate area that is required at those parts of the routes where the cylinders are operating with maximum effort; and, secondly that it is the force of the exhaust steam that is ejected from the high-pressure cylinders and is ejected through the funnel of the locomotive to the exclusion of incoming air, that creates and maintains this suction in the smoke-box, and effects the induced draught in the fire tubes of the boiler. Combustion of coal ranges from 40 lb. per square foot to 84 lb. per square foot. In the case of the L.M.S., before mounting Beattock or Shap the fire-grate is got into perfect condition for the maintenance of maximum combustion, and therefore of maximum evaporation of feed-water. With the greater boiler pressure of 250 lb. per square inch, all the greater storage of high-pressure steam is effected throughout the water in the boiler, and it takes all that storage of high-pressure steam to maintain the maximum of tractive effort, under adverse circumstances, for the required period. That is the feature of modern designing.

So long therefore as the locomotives must be coal fired, and be run on these three routes of the N.E., G.W., and L.M.S. companies, the locomotives as presently designed may be considered masterpieces. Their length is governed by the curves on the routes, and with coal firing any improvements must be expected to be of a minor character. The coal-fired locomotives that have two cylinders at both ends of the boiler at present—the "Fairlie" and "Kilmarnock" types—could not take up either of these three routes to advantage, and must be understood to have been designed for other purposes. It is known that the "Fairlie" type was designed for use in tropical climates, with the cylinders under the water tanks that have to be provided at both ends of the locomotive.

Compounded cylinders would not give the force of the exhaust steam from the low-pressure cylinder that would create the suction in the smoke-box that is required for coal-fired furnaces, and it would be impossible under the present circumstances to provide the present day maximum size of boiler to operate four cylinders at both ends—two high-pressure and two low-pressure—as the base plate cannot be made large enough with the curves that exist on these routes to-day. To enable that to be done, there would require to be one bogie at each end of the boiler, and four driving wheels, 5ft. diameter, between the two bogies, with a total length of outside wheel centres of 39ft., and the coal-fired furnace under these circumstances could not be accommodated. Within that length of approximately 39ft. for the L.M.S. route, the diameter of the driving wheels has to be 6ft. 9in. for supporting the size of coal-fired furnace that is required, and the dimensions of the boiler are governed by these two features of design.

When the production of oil from coal is an established industry in this country and the quantity of oil available is large enough for locomotive purposes, there can be effected considerable alterations of design. With gas or oil firing of fire tube steam boilers such great suction is not required for drawing the gases of combustion through the fire tubes, and many other advantages are made possible by a suitable design. For example, the heating area of the fire tubes and the superheating tubes can be doubled if necessary; and, alternatively, for the normal tractive powers of the present day the dimensions and weight of the locomotives can be reduced.

There is, of course, the possibility of internal combustion engines being used as the motive power of locomotives, when the production of oil from coal is widely adopted; but as that necessarily infers the generation of electricity by a direct-driven dynamo and the use of motors for direct drive on to the driving shafts of the driving wheels, the likelihood of that capital expenditure for accomplishing the operation of locomotives is, at the present day, unlikely.

Oil-fired steam locomotives that would have the tractive

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* The Engineer, pages 615–617, June 23rd, 1905.

power of the N.E., G.W. and L.M.S. locomotives would be about 38ft. long, and with driving wheels of 5ft. diameter would have lessened height above the rails. Under these circumstances, all the existing railways of the country, including the bridges and tunnels under which the rails run, could remain unaltered for countless generations, and the alterations of design of engine could proceed from compound condensing to whatever further design the engineers of the future found possible, without the shareholders of the railway companies being ever adversely affected. Their shares would rise in value, with less fear about the future, and the competition from the road.

WILLIAM DONALD.

Glasgow, October 24th.

SIR,—It appears a singular coincidence that on page 420, October 14th, you report Professor Naegel as attributing honour to the "struggles" of Hornblower and Woolf at a meeting presided over by Sir Henry Fowler; while, on page 423, a correspondent quotes an official report of tests on Hornblower–Woolf compound low-pressure locomotives, made thirty-six years ago, which revealed lower fuel consumptions per horse-power per hour than are realised at the present day—this a few paragraph's above the name of Sir Henry Fowler. Again, on pages 429 and 430, you deal with the anniversary celebrations of those Cockerill works in Belgium which were the first to build, for the Belgian State Railways, in 1904, the new locomotives then reverting to the Hornblower–Woolf system, but with the addition of receivers, which incidentally alter the form of the indicator diagrams. These plain but handsome Cockerill engines are shown in a large photographic reproduction on page 64, THE ENGINEER, July 21st, 1905, and are now of interest in the discussion on the M.E.P.'s in compound expansion from the fact that, in first starting, the M.E.P. in their cylinders must have been 150 per cent. of the boiler pressure—according to the official specifications then issued, namely, tractive-effort indicated =

$$P\,1{\cdot}5\,d^2\,l \div D.$$

Cockerills thus referred the total M.E.P. to the live-steam cylinders. The cut-offs were set so as to give equal piston-loads in all four cylinders at all the speeds, with only one valve gear for each pair of cylinders. H.P. and L.P.; and the engines were made to operate always in compound expansion from the first start, but provided with a sort of differential-valve which opened (into the receiver) only during the first quarter of a turn of the driving wheels, if and when the pressure in the receiver was not equal to the normal exhaust pressure from the H.P. cylinders—that is, one-fourth of the boiler pressure. But if the H.P. cylinders were the first due to take steam, then the exhaust steam from the H.P. prevented the differential from functioning. In any event this valve could only operate during the first quarter turn of the driving wheels. If it failed to open at all, the only effect was, for the first quarter of a revolution, to start up the train-hook pull the same as would do any two-cylinder ordinary engine.

The formula for the tractive effort that is more generally given by continental railways usually refers all the M.E.P.'s to the low-pressure cylinders: as $P\,0{\cdot}6\,d^2\,l \div D$, and the factor, 0·6, is obtained by dividing the indicated M.E.P. of the high-pressure cylinder by 2·4 or 2·5 (or whatever else may be the ratio of the cylinder volumes) and adding the sum thus obtained to the total M.E.P. of the low-pressure cylinders, so that, with higher ratios of cylinder volumes, this M.E.P. becomes less, although actually the tractive effort increases. With P 0·6 as referred to the L.P. cylinders, the M.E.P. when referred to the admission cylinders is 140 per cent. of the boiler pressure; but I notice that in the new American compound locomotives the M.E.P. where referred to the live-stream cylinders, and with engines working compound only, is 130 per cent. of the boiler pressure, or just 50 per cent. more than the maximum in the American simple locomotives (= 85 per cent.).

T. WITHAM.

Hampstead, N.W. 6, October 24th.

GERMAN EXHIBITS AT THE MACHINE TOOL EXHIBITION.

SIR,—I have much sympathy, which will be shared by many visitors, engineers and buyers, with the enforced attitude of the Selson Engineering Company, in resigning membership of the Machine Tool Trades' Association on the grounds so fairly set forth by their letter in your issue of the 14th inst. The absence from the next Olympia Show of this firm's exhibits will cause regret, seeing that they have been regular exhibitors since the very commencement.

As an old visitor to the many Machine Tool Exhibitions, I am very surprised at the narrow parochial outlook which the Association have continued by specifically excluding German exhibits, whilst admitting those of other continental states, especially as some of the latter have very little to show, whilst the former has a great deal, which would have enormously added to the attractions of the Exhibition. The action is neither "sporting" nor British, and for the sake of our good name and reputation, it is sincerely hoped that the members and Council of the Association will reconsider it and adopt a broader outlook.

Surely this decision can never have been come to through fear of German competition, the embargo being an attempt to stifle it. Neither, let us hope, is it a belated attempt to punish Germany for the war—a position too ludicrous for words. At any rate, it is undoubtedly a poor return for the cordial invitation annually offered by the Germans at Leipzic Fair, which a few British firms accept, and which, as everybody knows, is a Fair of immense importance to every commercial country in the world.

The fact is that Germany has made great headway during the last few years, particularly in the practice and production of modern machine tools and engineering shops plant; and it is in the general interest of our people, technical or otherwise, that they should have occasionally an opportunity of seeing such as may be presented for exhibition in this country. When the Association fail to recognise that they are lacking in service to the community. Is it not admitted that the effect of the American "invasion" of machine tools, small tools and sundries has been of immense value to this country in every possible way?

In the various displays in pre-war days, machine tools, &c. &c., of German and other foreign origin were quite an interesting feature of the Show, as it certainly gave visitors a wider range of interest, comparison and selection, all to the good and much appreciated, especially by those who came from other countries, colonies and abroad. Like the home visitor, these came to see the latest and best; in fact, were in quest of it, and country of origin was of secondary or remoter interest. In 1924 prejudice still lent savour to the then restrictive decision, but to the travelled man practically all that is now changed, and no longer holds; especially in a country like this with many of its industries languishing for lack of foreign trade, and every means possible is essential to secure it.

How can this wretched taboo decision help in British re-export trade, the interchange of commercial products with Germany, or how can it help in that friendship, amity, goodwill in commercial matters, nation to nation, just slowly developing through the mists of the war's aftermath, and which is so essential to national inter-trading?

Lastly, it may be pointed out that by common agreement the technical Press in this country has now restored or re-admitted German advertisements of machinery, inclusive of machine tools and accessories, which in keeping, many of our well-known makers and merchants offer on the factored side of their business, keep stock of, and constantly sell to purchasers in this country and abroad. Yet the Association short-sightedly refuse exhibition at their tri-annual Show of these commodities, and incidentally deprive visitors of the real educational value of display which, apart from the business side, all exhibitions stand for.

M.I. MECH. E. (VISITOR).

October 24th.

THE FLETTNER RUDDER.

SIR,—Mr. V. G. Martin seems to doubt the saving in coal consumption possible in vessels equipped with the Flettner rudder in place of steam steering gear. His main point of attack is the power absorbed by the Flettner fin or secondary rudder.

Let us therefore take a concrete example. In the case of the single ruddered motor ship Sorrento (2700 tons), which is considerably larger than the Liverpool boats, the area of the secondary rudder is 10·9 square feet, and its aspect ratio 7. By the nature of the control mechanism it is impossible for the fin to be placed at more than 45 deg. to the direction of motion. In the neighbourhood of this angle the normal pressure on the fin would be about 203 lb. at 11 knots, the speed of the ship. The fore and aft component of this force is 203 sin 45 deg. = 143 lb. The effective horse-power absorbed $= \frac{143 \times 18{\cdot}6}{550}$ (f.p.s.) = 4·8. Using a propulsive coefficient ·5, the brake horse-power absorbed from the engines would be about 9·6, *i.e.*, ·9 of 1 per cent. of the total brake horse-power (1050).

It will be seen therefore that the power required to operate the main rudder is negligible and cannot be compared in any way to the power developed by a steam steering engine. Further, owing to the Flettner rudder being of streamline shape and the fact that it adjusts itself to suit the conditions of the surrounding waters, it offers considerably less resistance than the normal plate type of rudder.

I agree with your correspondent that it is unfair to compare the handiness of the new Wallasey Ferry boats when leaving the stage with other vessels of the fleet owing to the varying shape of the hulls, and a true comparison can only be obtained with two vessels of identical dimensions and shape, one fitted with the Flettner rudder and the other with the normal rudder. The figures obtained at the rudder trials of the Marlowe, which were published in THE ENGINEER, are certainly convincing as regards the manœuvring capabilities of these new vessels, particularly in view of the fact that they are broader in the beam in relation to their length than the older vessels in the fleet.

As to saving in first cost—in vessels such as the Wallasey boats there is little to be gained over the normal type of steering gear, although in larger craft which with normal rudders and steering engine require elaborate stern frame castings, &c., there is a saving in first cost in favour of the Flettner gear of anything from 15–20 per cent., as the latter is considerably lighter and a simpler form of stern construction can be adopted.

With regard to maintenance there are less moving parts in the Flettner gear than in the steam gear. In the case of the Wallasey vessels should it be necessary to inspect the submerged control rods this can be done by trimming the vessels down by the bow and does not necessarily mean dry docking.

October 25th. F. A. BEST.

DERAILMENTS AND WHEEL FLANGES.

SIR,—With your permission, I will return to this question, I having my first experience over forty years ago of the importance and serious nature of a sharp engine wheel flange. While working in a running shed at that time, I was told to chip and dress the wheel flange of a six wheeled side tank passenger engine because of her derailment, with a view to prevent further trouble.

Later, while working in another running shed and having a little responsibility, I soon realised the need for tools of some kind to ensure safe running, because of the experience I had through attending so many derailments and having to report on the cause of same. I know of passenger and goods engine leading wheels taken out at great expense and put in the lathe for flanges only. I know of flanges being chipped and dressed quite recently, and all done through fear of derailment.

After very careful study over twenty years ago of this question, and having a very strong desire to prevent any engine under my care from becoming derailed through sharp wheel flanges, yet having no lathe, and not being able to get our engines to the shops just as we wished, I had to do something. Then I conceived of the possibility of making tools that could be applied to any wheel engine or tender—tender wheels requiring attention as well as engine wheels—engine to move in its own steam, either forward or backward, just as required, and in about fifteen or twenty minutes we have a dangerous sharp wheel flange safe. Now, in making that claim for my tools, I am very well aware that some adjustment requires to be made to suit the newest class of engines, but I am confident that in the hands of an intelligent tradesman all apparent difficulties could and would be overcome.

For twenty years I have been making inquiry as to what has been done or tried in the interest of safe running of our railways through defective engine wheels, and all I have been able to learn is exceedingly little. My long experience enables me to say that this question of wheel flanges has not had the consideration that its importance deserves.

October 24th. PROGRESS.

INVENTION IN RELATION TO PROGRESS.

SIR,—You quote Viscount Burnham as pointing out how the steam navvy has ameliorated the lot of humanity by "avoiding hard manual labour." I would ask him, then, is it better for Great Britain that one of the finest type of British workmen should hang about the street corner workless and hopeless, than that he should be happy in his true vocation, however rough or hard?

I would ask him, too, why the flower of our aristocracy (pre-war) bored with doing nothing, frequently sought out sports as strenuous and more dangerous than any navvying or mining "for amusement"?

The fact is that mankind was intended to labour according to his class and abilities, and unfortunately the engineer, in "ameliorating the conditions of life," has left the worker in the lurch; there is, of course, the happy medium; no one would deny the use of rail (though we are beginning to think about the use of road) transport, nor of the sailors calling in any capacity, but, for the rest, believing that the British race will indeed inherit the earth, I confess I regret the usurpation of the navvy's job by a mechanical apparatus, and there are innumerable instances of parallel cases.

For example, if this country will stop building oil-fired ships, except for war, and return to what we may call the coal standard, every one concerned will be better off. Over development is the old story of the combine or so-called "trust," which multiplies the millionaire's millions, but "grinds the faces of the poor." Let us stop development and retrogress one step in order to jump the better all together when the time comes, as surely it is coming, and when the demand for all our race to pull together will be paramount.

STANLEY PERCY CHRISTIE.

Exeter, October 19th.

PUDDLING FURNACES.

SIR,—My attention has been drawn to your report of the Presidential address which I gave before the Staffordshire Iron and Steel Institute on Saturday, October 8th. I would like to correct one point, and that is, where it is stated that the number of puddling furnaces in the district is less than twenty. What I intended to convey was, "that the number of works having puddling furnaces in active operation in the district is less than twenty."

FRANK S. WILKINSON,
President of the Staffs. Iron and Steel Institute.

Dudley, October 21st.

B.E.S.A. Specifications.

TWO-PIN PLUGS AND SOCKETS.

THE B.E.S.A. has just issued a new specification for reversible protected-type two-pin plugs and sockets with earthing connections, for circuits up to 250 volts between any two poles. In order to remove the confusion which often exists in the minds of the public as to which portion constitutes the plug and which portion constitutes the socket when these fittings are applied to portable apparatus, the opening section of the specification deals with definitions of these parts and their components, and also of various types of plugs and sockets.

In the specification proper the material, construction, and dimensions of the plug and socket portions are completely specified for the three standard sizes, the sizes being in terms of the rated current-carrying capacity. Thus interchangeability between plugs and sockets made by different manufacturers, and non-interchangeability between differently rated plugs and sockets are ensured. The specification calls for the case of the plug portion to be provided with a petticoat so that the contact pins are completely enclosed as soon as they enter the contact tubes, full protection to the operator thus being secured.

The Committee responsible for this specification recognised the desirability of a non-reversible feature for some applications of the plug and socket, but it was nevertheless considered convenient only to provide for the reversible type in the specification proper. In an appendix, however, details of construction and dimensions of a non-reversible plug and socket are referred to.

A further appendix gives drawings and dimensions of, and notes on, the proposed gauges for inspection of both the reversible and non-reversible plugs and sockets.

Copies of the specification may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

TRAMWAY RAILS AND FISH-PLATES.

A REVISED edition of the specification and sections for Tramway Rails and Fish-plates (No. 2, 1927) has just been published by the British Engineering Standards Association. In this new edition B.S. Section No. 9 (68·3 lb. per yard) has been omitted, as experience has shown that it is not required, and a new dwarf Section No. 10 (95·4 lb. per yard) has been included. It is intended primarily for carrying heavy loads on sleeper track. The text has been modified where necessary in accordance with these changes. The basic-Bessemer process for the manufacture of the steel has been eliminated in accordance with the recent decision of the Association. The omission of any reference to the weight of the tup in the revised edition of the B.S. Specification for Falling Weight-testing Machines (No. 103, 1926) which forms parts of Appendix 1 of the Tramway Rail Specification has necessitated the insertion of a statement in the clause in the latter dealing with the falling weight test, that the tup is not to weigh less than 1 ton.

Copies of the specification may be obtained from the British Engineering Standards Association, 28, Victoria-street, Westminster, S.W. 1 (price 5s., post free 5s. 4d.).

STANDARDISATION OF BALL BEARINGS.—At the International Standardisation Conference on ball bearings, which ended on Thursday, October 20th, representatives of the standardisation bodies of Great Britain, Sweden, Germany, Switzerland, Czechoslovakia, and Russia were present. According to a statement issued, the differences of opinion between the members were rather marked, but, owing to the spirit of goodwill which prevailed, valuable progress was made in standardisation work, and the conference unanimously adopted a proposed standard for radial ball bearings, which the representatives will recommend in their respective countries. On the whole the result of the conference was very satisfactory, especially when the considerable difficulties of international standardisation work are taken into account. The problems discussed had been very carefully prepared by Swedish experts.

The Transfer of Heat in Cylinder Walls.

No. III.*

Professor Dr.-Ing. Adolph Nägel, of the Technische Hochschule, Dresden, gave the third of his four lectures upon the transfer of heat in the cylinders of reciprocating engines, including internal combustion engines, at the Institution of Civil Engineers, on Tuesday, the 18th inst. The lectures were arranged by the Faculty of Engineering of the University of London, and, in the absence through illness of Sir Dugald Clerk, F.R.S., Professor E. H. Lamb, the Dean of the Faculty, took the chair.

In this lecture Professor Nägel dealt more especially with his own tests upon a "Uniflow" steam engine in the Heat Engines Laboratory at Dresden, which were commenced in 1911. After the practical success achieved in 1908 by Professor Stumpf, of Berlin, upon the uniflow engine, it was felt that more should be known of the reasons for the thermodynamic advantages of that engine. The "Science Committee" of the Verein deutscher Ingenieure therefore commissioned Professor Nägel and his colleague, Professor Mollier, to undertake tests in connection with the problem. These tests resolved themselves into an investigation of the heat transmission between the steam and the walls of the cylinder. An engine in the laboratory was adapted for the work, a new cylinder, 450 mm. diameter and 650 mm. stroke, presented by the M.A.N. works at Nuremberg, being used. The valve gear was of the Lentz type, with horizontal rods, the point of cut-off being under the control of the governor. The piston was fitted with six rings, three at each end.

The steam from the boiler was passed through a separately fired superheater, and on its way to the inlet valve it was led through the cylinder cover steam jacket. A condenser capable of a high vacuum was specially provided. The energy given out by the engine was dissipated electrically, and in all measurements the highest possible degree of accuracy was striven for. In all the tests the steam was supplied at a pressure of 11 atm. absolute (about 157 lb. per square inch), and the absolute back pressure was 0·1 atm. (about 28in. vacuum). Great care was taken with the thermo-couples used for the temperatures of the piston and the walls. The elements consisted of copper and constantan wires, 0·5 mm. diameter, supplied by Messrs. Basse and Selve, of Altena, Westphalia; before using, the thermo-electric properties of these wires were carefully checked. A Diesselhorst compensator served for the measurement of the electromotive force. The indicator selected for the steam indicator diagrams was one with external spring made by Messrs. Dreyer, Rosenkranz and Droop, of Hannover.

The indicator reducing mechanism consisted of a lever of hard wood fitted with gun-metal bearings, the drums being actuated by steel tapes, 5 mm. wide and 0·1 mm. thick. By a special device, one movement of a handle caused the connection between the reducing lever and drum to be effected in a manner free from shock, but only at a dead centre. At a later dead centre one movement of the handle disconnected the band and brought the drum again to a standstill without shock. To allow this gear to act without restraint, the ordinary drum spring was removed and replaced by a spiral spring of adjustable tension. This spring, fastened to the cylinder, was carried in a housing whose rotation provided the adjustment desired. With the high degree of accuracy which these special arrangements permitted, it was considered that the expansion and compression curves of the diagrams did actually represent the conditions in the cylinder, and that a microscopic analysis of the cards was justified. A special apparatus was used for such an analysis, one advantage being that it was not necessary to draw lines of any kind on the diagrams. Special arrangements were made for measuring the steam used, and also the quantity of air trapped in the steam. Professor Nägel, however, only referred briefly to this general apparatus, as that for temperature measuring and indicating is relatively of greater importance.

Fig. 5 shows a longitudinal section through the cylinder, giving the position of the several thermometers and thermo-couples used for measuring the temperatures of the steam and wall. In the cylinder cover five axial tubes or bushes may be seen. These penetrate the cover jacket—which is also additional steam receiver volume—and the steam chest in which the valve cage is situated, and end at the inner surface of the cover. The central bushing was intended to carry a thermometer for the steam. It was early found necessary to obtain the temperature range of the outer surface of the piston, and a hollow tail-rod, 40 mm. diameter, was passed through this central hole and kept steam-tight by means of a Lentz stuffing-box, as shown in the figure. The remaining holes in the cover generally carried two measuring points for the steam temperature and two for those of the surface of the cover.

The steam thermometers, following Callendar and Nicolson, were of the resistance type. The resistance wires, 0·01 mm. diameter, were of tungsten. About 100 mm. of this wire was arranged in zigzag form, held by platinum hooks fused into glass, and connected to chemically pure copper wire, 1·0 mm. diameter, with binding wire of platinum. The copper leads were insulated and protected by passing them through porcelain rods, 10 mm. diameter, inserted through the bushes in the cylinder cover, into which they were fastened and made steam-tight. The tightness of the wires in the holes, of 2 mm. diameter, in the rods was ensured by cementing them with a paste of litharge and glycerine. The porcelain rods were made, with two and four holes, in lengths up to 2·5 m., by the Porzellanfabrik Freiberg. The holes were so accurately made that all four could be seen through at the same time. The first tests with these thermometers were very disappointing. The E.M.F. that set up a current of 0·001 ampères fluctuated so much that the values could not be measured. The phenomena of Armstrong's steam-electric machine offered an explanation for this. The surface of the porcelain rods projecting into the steam space had become electrically charged by the friction of the whirling steam. This difficulty was entirely overcome by gilding the outside of the rods close to the edges of its holes.

The position of the porcelain rods could be adjusted after the stuffing-box packing had been loosened. The piston was fitted with corresponding tubes, which, as they moved to and fro, passed over the ends of the porcelain rods in the steam space—as seen in Fig. 5. To ensure that the increase of clearance volume should be as small as possible, and also to restrict the area of surface exposed to heat transfer, a radial clearance between porcelain rod and tube of only 3 mm. was allowed. No difficulty was encountered during the tests, even when the thermometer projected as far as 500 mm. into the piston chamber.

Radial holes, 15 mm. in diameter, were drilled at seven points in the wall to accommodate the thermo-couples. Plugs, made of cast iron of similar quality to that of the cylinder, were ground into these holes, as shown in the left of Fig. 6, which shows also the design of the thermo-couple. As will be seen, the plug is in two parts, the inner part being in the form of a plate 5 mm. thick, of the same cast iron as the main part of the plug and ground on to the latter. It is fastened to the latter axially by means of a screw. Two holes, of 2 mm. diameter, are drilled axially 6 mm. apart through the main plug and carried into the plate up to 0·5 mm. from the inner cylinder wall, where the bottom of the hole is milled out hemispherically. The remaining wall thickness was carefully measured. A hole of 0·5 mm. diameter is drilled through the remaining thickness of the plate, into which the copper or constantan wires are secured by riveting. The wires, with the neutral material of the plate, form a thermo-couple, and the point at which the wires come through the cast iron plate, *i.e.*, at 0·5 mm. from the inner surface of the cylinder wall, is that at which the temperature given by the E.M.F. prevails. The wires are insulated within the 2 mm. diameter holes of the plug by glass beads, as seen in the right of Fig. 6, and outside the holes by glass or rubber tubing. The lecturer pointed out that, in view of the experience gained with these plugs, he would not call them perfect. In future designs, for instance, he would dispense with the plate, and further, would, if possible, drill the holes directly into the cylinder wall in order to obviate the resistance of the ground contact faces. It might also be possible to have the holes of smaller diameter than 2 mm., insulating the wire by very thin quartz tubes, or only by lacquer that would stand up under high temperatures.

Near the outer end of every plug a second thermo-couple is attached by screws to the outer surface of the liner, in order to give the temperature gradient in the cylinder walls, which are protected on the outside by lagging. The temperature at the outer wall of the cylinder cover was measured in a similar manner. The situation and the construction of the thermo-couples for measuring the temperature of the piston may be understood from Fig. 5. The wires from the thermo element were carried in glass tubes. These were inserted into steel tubes and bent hot with them to follow the contour of the piston crown. A groove was cut in the piston crown to receive the two steel tubes, which were connected to the auxiliary piston-rod and to the plug of the thermo element by flanges. The auxiliary rod is hollow and contains a porcelain rod, similar to those described earlier, through which the wires of the thermo-couple are led, suitable arrangements being made to ensure steam-tightness and to insulate the wires completely. To allow for the to-and-fro motion of the piston-rod the conductor wires were bound together and to a steel wire at the outside. This wire was hung from a spiral spring attached to a point in the ceiling, the wire swinging freely horizontally and vertically with the motion of the outer end of the auxiliary piston-rod. It had been emphasised that sliding contact should not be permitted in any circuit of the thermo-couple, since the mech-

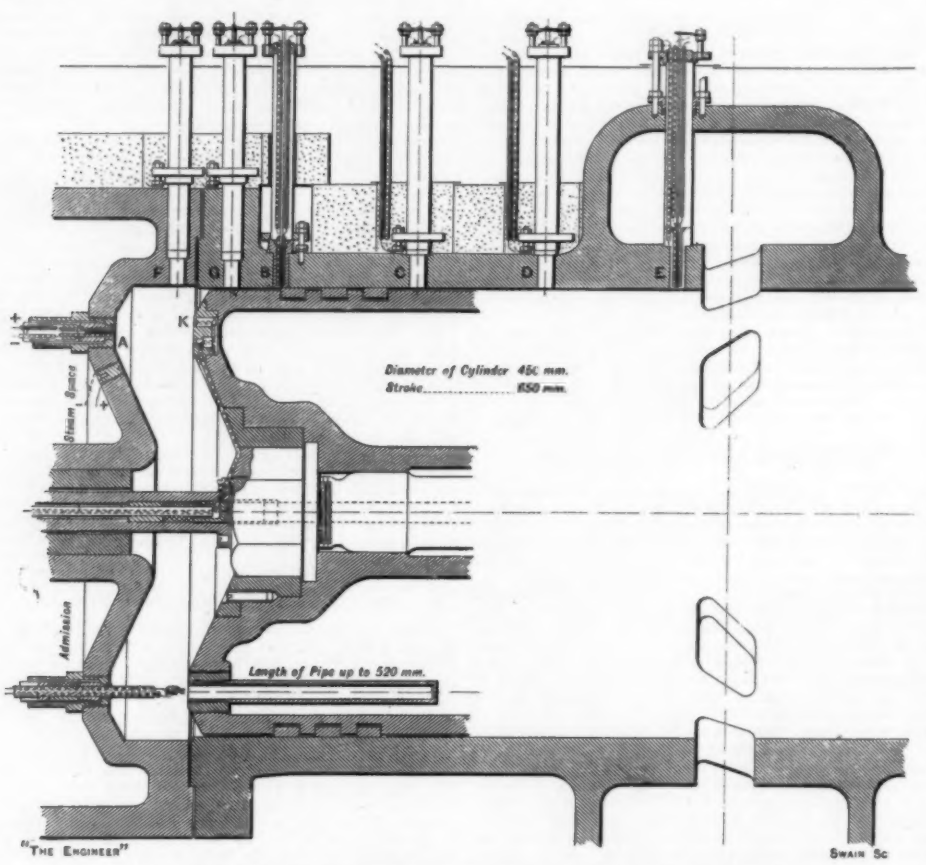

FIG. 5.—SECTION THROUGH UNIFLOW CYLINDER AS ARRANGED FOR TESTS

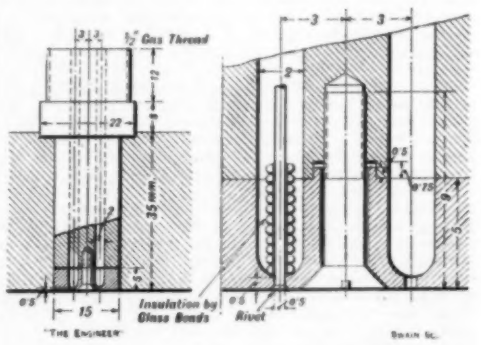

FIG. 6—ARRANGEMENT OF THERMO-COUPLES

* No. II. appeared October 21st.

anical friction set up might cause misreadings owing to momentary electrostatic charges. The Einthoven "string" galvanometer, made by Edelmann, of Münich, was used instead of the Poggendorf compensator, which had not proved satisfactory. In this type of instrument a gold or platinum thread, in the circuit under test, is stretched between the poles of an electro-magnet which is excited by a constant current. The pole pieces are bored out so that the position of the thread may be observed and indicated microscopically. When a current passes through the thread it is deflected, according to the law of Biot-Lavant, until the E.M.F. and the elastic reaction are in equilibrium. In the experiments this deflection when projected on to a screen was magnified 1000 times. A drum, around which sensitised paper was wrapped, and with its axis horizontal, was rotated at constant speed behind the screen and on it a curve of E.M.F. or temperature was made photographically on a time basis. The exposure of the drum to the light was arranged through a slit, 0·2 mm. wide, in a shield. The shield was operated by a contact apparatus attached to the valve gear and was opened and closed at definite crank angles to include, as desired, one or more revolutions of the crank. In making the tests one diagram was made at each measuring point during one revolution, and a second during four revolutions, the second being to prove the regularity of the conditions under which the first and real record was taken. In order to correlate the crank angle with the time base of the photographic record or diagram a spark was caused to pass at the dead centres and at 90 deg. and 270 deg.; this was photographed on the diagram. To ensure that the galvanometer should not be influenced by any external wall or foundation vibrations, it was suspended from four long steel wires.

To render the galvanometer as sensitive as possible, a suitable counter voltage, constant during each observation, was passed through the measuring circuit so that the deflections measured the differences above and below a certain mean temperature corresponding to zero deflection of the thread. This can be done in a few seconds, and afterwards the tension of the thread is so regulated that, where possible, the maximum difference of temperature from the mean should be shown with the maximum convenient deflection of the thread. The different thread tensions require a special adjustment of the instrument for each diagram. For this purpose the E.M.F. necessary to set up a current of 0·001 ampère, which is always constant, in a variable and known resistance is applied to the thread circuit. The deflections of the shadow line of the thread on the diagram corresponding to certain values of the E.M.F. are marked by fine wires strung on a sliding frame in front of the slit through which the light band passes. By this means it is possible to adjust the galvanometer within twenty seconds of photographing a diagram, and to obtain six or eight gauging lines on the diagram.

In calculating the relation between the value of the E.M.F. and the gauge lines the resistance of the thread is, following Kirchoff's law, taken into consideration. The constant current of 0·001 ampère, referred to, across the ends of a standard resistance was applied by means of the compensator of Professor Diesselhorst, of Brunswick. The main temperatures of the steam end of the inner and outer wall surfaces were measured with the same compensator, so that the resistance of the connecting leads had no effect on the measurements. The calibrating current of 0·001 ampère is used, at the same time, as load current of the resistance thermometer used for indicating steam temperatures.

Professor Nägel showed slides and originals of his diagrams of temperature variation, of which Fig. 7 is typical, and described the interesting conclusions which can be drawn from them. In the diagrams of steam temperature the high values found at points in the clearance space at the end of compression are especially worthy of note. This effect had already been observed by Callendar and Nicolson and also by Duchesne—see Lecture II. On that part of the diagrams showing the compression period a distinct break is to be seen, at which the temperature begins to rise more rapidly, which must be assumed to mark the transition from saturated to superheated steam. The temperature on two diagrams rises during compression to 420 deg. and 333 deg. Cent. respectively, but decreases rapidly at the point of admission to the temperature of the steam admitted. The temperature range of the steam near the cylinder cover was found, in accordance also with Callendar and Nicolson, to depend largely on the position of the measuring point.

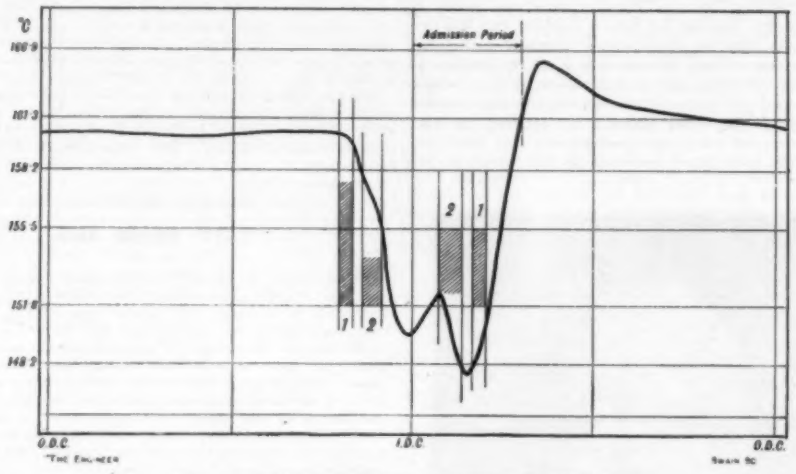

FIG. 7—TYPICAL TEMPERATURE VARIATION DIAGRAM

Fig. 7 shows the temperature variation at the point B in the cylinder liner—see Fig. 5—with the admission steam saturated. It is of interest to consider the conditions as found at the various measuring points of Fig. 5. The first important circumstance referred to by the lecturer was the very marked effect of the piston rings upon the heat transferred to, and therefore the temperature variations of, the various points in the liner. This will be referred to again later when considering Fig. 7 in detail.

For the points A_2 and A_3 in the surface of the cylinder cover, and for the point F in the cover flange, the temperature variations during a cycle are remarkably small, and amount only from 1 deg. to 2 deg. Cent., with saturated steam at a low speed of revolution, 81·8 r.p.m. The temperatures at the points A, B and C in the cylinder wall gave quite a different range. They are passed over by one, two and three piston rings respectively. The rings were numbered 1 to 6 from the piston crown, so that point B in Fig. 5 is passed over by Nos. 1 and 2. The time intervals during which the rings passed the points were drawn and shaded on the diagrams, and, as the figure shows, the close connection between wall temperature and the position of the piston rings is definitely established. Considering the diagram, Fig. 7 and beginning with the compression stroke, it will be seen that the variation of temperature is small until ring No. 1 reaches B. This and ring No. 2 have been at the outer dead centre, *i.e.*, the middle zone of the cylinder, and in contact with cold exhaust steam and cold walls. They make the return stroke at relatively high speed, and with the temperature difference over the greater part of the stroke increasing proportionally slowly, do not take up much heat. The nearer the piston approaches the inner dead centre the lower is its speed and the higher the temperature of the wall, so that there is a rapid transfer of heat from the wall to the rings near to the inner dead centre. This is most marked on the in-stroke, as may be noted in Fig. 7. After the inner dead centre the temperature at B begins to rise, but this rise is retarded greatly by ring No. 2, but, on the other hand, increased very slightly by ring No. 1, which has become heated. After the latter ring has moved on outwards, the temperature at B rises up to its maximum value just after the point of cut-off and then falls as expansion proceeds. The extreme range of temperature is from about 148 deg. to 166 deg. Cent., *i.e.*, 18 deg. Cent., at point B. It should be emphasised that these temperatures are at a depth of 0·5 mm. below the surface of the wall, which accounts for the slight lag to be observed at certain points. The variation at the wall surface would also be considerably more marked.

At the point G, 50 mm. nearer than B to the cylinder cover, and passed over by No. 1 ring, the temperatures at the end of the admission period reached their maximum value of 172 deg. Cent., the range being 23 deg. Cent. against 18 deg. Cent. at B. At C, 135 mm. farther into the cylinder than B, the influence of the rings was found to be smaller than that of the steam in contact with the wall, the range of variation being only 7 deg. Cent. At D, about 128 mm. beyond C, two piston rings of the other side of the piston come into the question, *i.e.*, Nos. 4 and 5. All these rings are hotter than the wall, and therefore give heat to it. The range of variation at this point is 10·5 deg. Cent. Point E is touched by all six piston rings, and has a very irregular temperature, the range being 12 deg. Cent. The thermo-couple in the piston surface at K records a temperature variation of about 6 deg. Cent.

The temperature curves, in order to be of use in further calculations, were analysed by the Fourier series method. Professor Nägel tried, at first, to utilise the harmonic analyser of Dr. Mader, but owing to the steepness of the temperature changes recorded, these had to be divided over a greater number of members of the Fourier series than could be done by Mader's analyser. Special tables were therefore developed, by which the particular character of a temperature curve was recorded by series of the 12th, 18th, 24th or 36th orders.

Assuming, for the cast iron of which the cylinder was made, a coefficient of heat conductivity of 56 K. cal. per square metre, per metre, per degree Centigrade, per hour, a specific heat of 0·115 and a specific gravity of 7·25, the temperature range at the

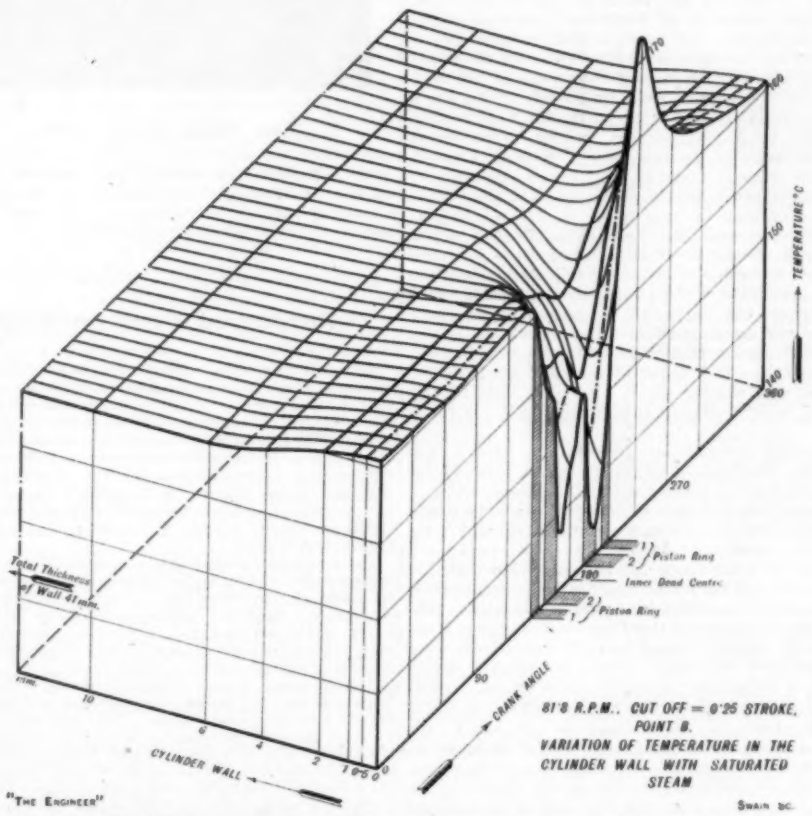

FIG. 8—TEMPERATURE VARIATION THROUGH CYLINDER WALL ON CRANK ANGLE BASIS

inner wall was calculated for all measuring points. The distribution of the temperature through the wall was determined at successive crank angles for certain of the points and plotted in three dimensions. That for point B is shown in Fig. 8. It will be noticed that the temperature variations increase from a nearly constant value, *i.e.*, practically zero variation, at 6 mm. depth to a range of 29 deg. Cent. at the surface. The broken curve, with its range of 18 deg. Cent., is the photographic diagram of Fig. 7, from which the other values were calculated in the manner described. The areas showing the influence of the piston rings are shaded. With this diagram Professor Nägel concluded his third lecture.

(To be continued.)

Obituary.

SIR GERARD ALBERT MUNTZ.

The death took place, suddenly on Saturday last, at his home, Tiddington House, near Stratford-on-Avon, of Sir Gerard Albert Muntz, Bart. Sir Gerard had attended the Council dinner of the Institution of Mechanical Engineers on the previous evening, and had then appeared to be in good health.

Gerard Albert Muntz was born on November 27th, 1864, and had therefore nearly completed his sixty-third year. He was the son of the late Sir Philip Albert Muntz, Bart., and he succeeded to the baronetcy in 1908. He received his education, first of all, at Harrow, and afterwards at Victoria College, Manchester, Neuwied-on-the-Rhine, and King's College, London. In 1883, when only nineteen years of age, he entered the French Walls Works at Birmingham of Muntz's Metal Company, Ltd., and he devoted the whole of the remainder of his life to the service of that undertaking, become eventually managing director in 1916 and consultant director in 1921. But besides attending to the ordinary business of a large company he found time to undertake a great deal of research work in connection with the properties of the non-ferrous metals, and particularly of copper and copper alloys. It is perhaps not too much to say that his life was one long research in this direction. He became a recognised authority on the corrosion of the non-ferrous metals generally, and especially of brass condenser tubes, and of the sheathing of wooden vessels under the action of sea water. His investigations, which extended over a very lengthy period, resulted in a number of important discoveries, many of which he gave to the world in papers which he read before the various scientific institutions and societies to which he belonged, as well as in numerous articles which he contributed to different technical journals. He also frequently took part in the discussions on the papers, read by others, which dealt with the subjects he had made particularly his own.

Sir Gerard was, we believe, largely instrumental in the formation of the Institute of Metals, of which he was an original member, and a vice-president in 1909. In the same year he contributed to the "Proceedings" of that body a paper on "The Relation between Science and Practice, and its Bearing on the Utility of the Institute of Metals." In this paper he subdivided his subject under the following heads:—(*a*) The correlation of the manufacturer, scientist and engineer; (*b*) the reduction of science to practical form; (*c*) the determination of the causes of failure; and (*d*) the classification of knowledge regarding non-ferrous metals. The paper attracted a good deal of attention, and among those who took part in the discussion which followed it was the late Sir William White.

In his first presidential address Sir Gerard discussed the development of the Institute, but on the second occasion his subject was "The Reason Why—the Quest of the Institute of Metals." In it he made reference to the Corrosion Committee, of which he became Chairman in 1911.

In spite of a strenuous life in connection with his own business and his researches, Sir Gerard still found time to extend his activities in other directions. He was made Chairman of the Brass and Copper Tube Association, and continued to hold that position for ten years, and Chairman of the Associated Manufacturers of Brass and Copper Tubes of Great Britain. He was also consultant director of Elliott's Metal Company, Ltd., of Selly Oak, Birmingham. He became a member of the Institution of Mechanical Engineers in 1910, and held the office of Vice-president from 1919 to 1925, when, owing to ill-health, he resigned that position so that the election of someone else might not be barred. Last year he was re-elected Vice-president. He was also a Fellow of the Royal Society of Arts, a member of Council of the Birmingham Chamber of Commerce, and from 1915 to 1917 Chairman of the Non-ferrous Trades Committee. At the meetings of these committees and associations he was a frequent attendant and speaker.

During the Great War Sir Gerard did good service to his country. He was Chairman of the Non-ferrous Metals Committee (Board of Trade) in 1916, and the following year, and Chairman of the Metallurgical Committee (Ferrous and Non-ferrous) Department of Scientific and Industrial Research from 1916 to 1919. Subsequently, he became member of Council of the British Non-ferrous Metals Research Association, a member of the Copper, Zinc and Lead Sectional Committees of the Imperial Mineral Resources Bureau, a member of Council of the British Non-ferrous Metals Research Association, and a member of the Committee on Trade and Commercial Policy. As showing in what esteem he was held by the authorities of Birmingham University, we may say that a year or so ago he was awarded the Thomas Turner Gold Medal in recognition of "Exceptional Merit in the Service of Metallurgy."

His personality was of a kind that made him popular amongst his fellow-engineers, for he was naturally of a very cheerful disposition. In his youth, as he was fond of recalling, he had been an amateur boxer of no small merit, and as he was a man of big stature he must have been an opponent to command respect. During the war, when, like so many others, he found it necessary to have some occupation which would take his mind far away from the engrossing worries of the day, he amused himself by writing novels, one of which at least was published. He had, we believe, just completed another at the time of his death. He was wise and kindly in counsel, and both on that account and on account of the specialised knowledge which he possessed, his death will be widely deplored amongst engineers.

SIR GERARD ALBERT MUNTZ

Pulverised Coal on Ships.

Experiments on powdered coal, under the Fuel Conservation Committee of the Merchant Fleet Corporation, with the collaboration of the Navy Department, have, says *Iron Age*, been conducted in the Philadelphia Navy Yard. The results have been so favourably viewed that the Shipping Board steamer Mercer, of 9730 deadweight tons, is to be fitted with equipment for burning powdered coal and tested at sea. If this proves successful so far as economy of operation is concerned, the standard installation worked out for this vessel could be applied to twenty-two others.

Pulverised fuel equipment to be used involves a bunker arrangement, conveyor for bunker fuel, pulveriser, distribution of pulverised fuel to each furnace and burner equipment. Both the bunker arrangement and the conveyor system are designed to reduce to a minimum the man-handling of coal. This will result in reducing both the operating wage and the subsistence cost.

The proposed arrangement is to install a daily supply bunker above each pulveriser, into which will be fed a fuel supply for twenty-four hours. This coal will be carried up from the main bunkers by endless chain conveyor and discharged into a crusher. Large lumps of run-of-mine coal will be broken to a maximum of 1½in., and the crusher discharges by gravity into the daily bunker. This in turn discharges by gravity into the feeder for the pulveriser mill. Crusher and conveyor are designed for filling the daily bunker in about two hours, leaving the remainder of the time for the coal passers to trim fuel from coal pockets to the conveyor feed hopper.

Two pulverisers, each with capacity of 3600 lb. an hour, should permit the vessel to operate on one, with the other as stand-by. In operation, however, it is planned to run both mills at half load, grinding the coal finer. This degree of fineness has a definite bearing on the efficiency of combustion. A slow-speed ball tube mill will be used, resulting in lower maintenance charges, it is believed, than with a high-speed mill.

A blower fan will draw coal from each mill into a common distributor. This will divide the single coal and air stream into three streams, one for each boiler. Each of these in turn will be divided into three smaller streams, one for each burner. The distributor is a vertical four-bladed paddle wheel operating in the coal and air line and mixing up the coal and air into a homogeneous mixture.

Burner equipment is to be of the turbulent type. It is a combined coal and oil burner and register, permitting the vessel to change over from one fuel to the other almost immediately, if required. This will make it possible to light the furnaces with oil or to operate the vessel in port with oil or while manœuvring, if found necessary. It is expected to develop the pulverised coal system, so that this arrangement may not be needed, but the initial installation will have this precaution.

Bunker fuel of about 14,450 B.Th.U. a lb. may be compared with oil at 18,300 B.Th.U. Allowing 3 per cent. differential for the cost of preparing the coal for atomisation, it will require 1·306 lb. of coal to do the work of 1 lb. of oil. Oil at 1·75 dollars a barrel is 11·60 dollars a ton, compared with 6 dollars a ton for coal. This means that the fuel cost for the pulverised coal burner on equal power would be about 67½ per cent. of that for oil. The saving at sea should be about 100 dollars a day.

Various alternative calculations have been made on the basis of using cheaper coal of lower heat value, and allowance has been figured for three coal passers, which later may be reduced to two. The various daily savings range from about 85 to 139 dollars, as estimated.

SIXTY YEARS AGO.

Camouflage by smoke screens against aerial observation was, it seems, successfully practised sixty years ago. According to a paragraph in our issue of October 25th, 1867, military aeronauts had not met with much success in the war in Paraguay. Frequent balloon ascents were made, but as soon as a balloon was seen rising Marshal Lopez ordered great fires to be kindled, the smoke from which covered his camp and prevented the allies from discovering what was going on therein. . . . In another paragraph in the same issue, we sought to show the extent to which iron steamboats were superseding wooden steamboats by recording the fact that in 1866 only forty wooden steamers were built in England, as compared with 283 iron steamers. . . . In those days the corrosion and fouling of the hulls of iron vessels was a very serious problem, and many plans had been proposed and tried to solve it. In the issue referred to we gave particulars of a system evolved by Monsieur Roux, a captain in the French Navy. Eight French ironclads had already, we stated, been treated according to Monsieur Roux's system, and it was said that the French Government was about to adopt it for every armour-plated ship which it possessed. The system consisted of attaching copper sheathing over the iron hull, but that simple statement hardly conveys a proper idea of the work involved. Blind holes were drilled, by hand, in rows marked off along the hull. These holes were then countersunk and next recessed or undercut near their blind ends by means of a collapsible spring bit. Copper rivets with recessed bases and collars halfway up their lengths were inserted in the holes and were riveted tightly into position with the aid of a special snap applied over their ends. The copper flowed into the undercut and the collar on the rivet bedded down into the countersink. The hull, previously scaled and cleaned, was given two coats of red lead paint, followed by a coat of coal tar and two coats of a material described as "Roux-mastic." A sheet of lead foil was applied over the ends of the rivets which were brought through the foil by punching with a special tool after the foil had been placed against the rivet-studded hull. Finally, the copper sheathing, previously punched to register with the rivets, was applied and fixed in position by snapping down the rivet ends. The array of special punches, drills, snaps and so on required to carry out the scheme was very extensive, and was fully illustrated in our pages. The process must have been a very expensive and slow one, especially by reason of the fact that all the holes had to be drilled by means of a hand brace, and all the riveting done by means of manual labour.

BOOKS RECEIVED.

Technical Drawing. By G. E. Drayeott. London: The Oxford University Press, Falcon-square, E.C. 1. Price 6s. net.

La Produzione di Energia Elettrica in Italia nel 1926. Rome: Provveditorato Generale Dello Stato Libreria. Price livres 10.

Water Channels. By G. Higgins. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 2s. net.

The General Theory of Thermodynamics. By J. E. Trevor. London: Ginn and Co., 7, Queen-square, W.C. Price 7s. 6d. net.

Canada: Geology, Mines and Metallurgical Industries. By Wyatt Malcom and A. H. A. Robinson. Ottawa: Department of Mines.

Constructional Steelwork Simply Explained. By Oscar Faber. London: The Oxford University Press, Falcon-square, E.C. 1. Price 6s. net.

The Working of Coal and other Stratified Minerals. By H. F. Bulman. London: Ernest Benn, Ltd., Bouverie House, Fleet-street, E.C. 4. Price 42s. net.

City and Guilds of London Institute: Department of Technology, Programme 1927–28. London: John Murray, Albemarle-street, W. 1. Price 3s. 6d. net.

Annali dei Lavori Pubblici (gia Giornale del Genio Civile). Ministero dei Lavori Pubblici, Consiglio Superiore. 1927. Nos. 6 and 7, Giugnio and Luglio. Rome: Provveditorato Generale Dello Stato Libreria.

The Electrical Industry and the Consumer: Basic Factors Governing Price Tendencies. London: The British Electrical and Allied Manufacturers' Association, Inc., 36, Kingsway, W.C. 2. Price 1s. net.

The Trade Disputes and Trade Unions Act, 1927. By L. B. Ferguson. With a Foreword by the Right Hon. Lord Askwith, K.C.B. London: Butterworth and Co. (Publishers), Ltd., Bell-yard, Temple Bar, E.C. Price 5s. net.

Railway Matters.

The coroner's inquest into the cause of the thirteen deaths that resulted from the Sevenoaks derailment of August 24th was resumed on Wednesday and continued yesterday—Thursday. It was not completed at the time we went to press.

The Railway Rates Tribunal met on October 19th to fix the date on which the new terms and conditions governing merchandise, livestock, and damageable goods, not protected by packing, and carried by rail, should come into operation. The terms and conditions had previously been settled, and, there being no opposition, January 1st, 1928, was the date fixed.

The whole of the rolling stock on the Central London Railway is undergoing remodelling to bring it up to the same standard of comfort and efficiency as that of the other associated lines. There are at present 1545 cars in daily service on the "Underground," and when all deliveries of new rolling stock are completed a further sixty-two cars will be available, which will have seating accommodation for 2600 passengers.

The German State Railways have recently made some experiments with locomotives which are constructed to burn powdered fuel obtained from the distillation of brown coal. It is understood that the railway authorities will purchase large tracts of brown coal deposits with a view to erecting distillation plants, thereby safeguarding their supplies of the required fuel. The proposal is one of interest in view of the large deposits of brown coal which exist in our Dominions and Protectorates.

Under the new passenger charges that the Railway Rates Tribunal has fixed and which come into force on January 1st next the companies will be permitted to raise certain of the existing fares that are now below the general level of 2½d. per mile first class, 2d. per mile second class, and 1½d. per mile third class. An official announcement of the companies says, however, that no third-class single fare will be raised more than 2s. and no first-class more than 3s. 4d. In some cases there will be a reduction.

The Institution of Railway Signal Engineers now admits as associates persons who, whilst not signal and telegraph engineers, are interested in signalling. The purpose of the change is to get such men as civil engineers, locomotive and operating officers to take part in the discussions. At the annual dinner of the Institution on October 21st the President announced that the first associate was Mr. John Miller, the chief engineer for the North-Eastern Area, London and North-Eastern Railway.

The London, Midland and Scottish Company is about to provide a number of glass-lined tanks for the conveyance of milk in bulk by passenger train. The tanks will be well insulated to guard against the ill effects of changes in temperature, especially during hot weather, will have a capacity of 3000 gallons, and be carried on steel underframes. The weight, loaded, will be approximately 24 tons, and, when empty, it will be about 11 tons. When sent in churns, as now, 3000 gallons of milk require three milk vans.

Mention is frequently now made in the newspapers of the running of the Royal Scot non-stop Euston–Carlisle express, but one run lately stands out pre-eminently. On Thursday, the 13th, driver James Bilburn, of Carlisle, took the train and passed Lancaster four minutes before time, Tebay eight minutes and Shap ten minutes, and arrived at Carlisle nine minutes before time. The 300 miles were thus covered in 336 minutes. It is now announced that some of the night trains are to run between Crewe and Glasgow, 244 miles, without change of engines.

In this column of our issue of July 29th last some figures were given of the punctuality of the steam-worked and electrically operated trains on the Southern Railway during the months of April and May last. The principal holiday month of August is, of course, a more severe test, but it is satisfactory to know, on the authority of the *Southern Railway Magazine*, that of 99,828 steam-worked trains 60,298, or 60·40 per cent., arrived punctually; 26,400 were not more than five minutes late; 7629 were from six to ten minutes late; 4154 from eleven to twenty minutes; and 1347 over 20 minutes late. The average lateness was 2·26 minutes. Of 61,119 electrically operated trains 47,530 arrived on time and only fifteen were more than twenty minutes late. The average lateness of the electric trains was 0·61 minute.

At the Central Argentine meeting on the 13th inst., the chairman congratulated the proprietors on his being able to present them with the best report in the company's history. In the course of his speech, Lord Forres made the interesting announcement that the Argentine Government and the public had been a good deal agitated from time to time concerning the present terminal facilities for passengers in Buenos Aires. The directors were considering the feasibility of sharing the use of the terminus at Retiro with the Buenos Aires and Pacific Railway. It was not an easy question and required the closest study and consideration. If a suitable scheme for joint operation could be evolved such a solution would no doubt meet with the approval of the public. They had not yet reached a position in which they could say more on the subject.

Whilst there were seven fatal passenger train accidents in 1877—fifty years ago—in five of them only one passenger was killed in each and the total for the year was the loss of 13 lives. Tuesday the 18th, was the anniversary of the second most serious accident of the year, and one in which three passengers were killed. The origin of the accident lay in some wagons leaving the rails at Castle Ashby on the Northampton and Peterborough branch of the London and North-Western Railway, which involved single line working. That was put into operation by the traffic inspector, but the signalman at Castle Ashby—who had been only three months on the railway and with five weeks' experience of a signal-box—broke the regulations and allowed the ballast train to foul the single line whilst the pilotman was absent. A passenger train consequently ran head-on into the ballast train and three passengers were killed. It was twenty years on Saturday, the 15th, since the Shrewsbury disaster, when 11 passengers were killed.

Notes and Memoranda.

Some extensive tests carried out by the Standard Oil Company have proved that the foam method of fighting oil fires is ineffective unless the foam is applied gently at the surface of the burning oil. A 55,000-barrel tank burned right out although enough foam was dropped into it to form a blanket 6ft. thick. When, however, the foam was applied through asbestos pipes reaching to the surface, experimental fires in the same tank were quickly put out.

It has been suggested by Mr. Kenyon, of the Victorian State Rivers and Water Supply Commission, that the difficulties of supplying farmers with irrigation water, caused by the porous nature of the soil in the Mallee country, might be overcome by providing artificial catchments. He estimates that 90,000 gallons of water a year will provide a farm of 640 acres and proposes to collect sufficient rainfall by a catchment area of 26,000 square feet made of galvanised iron.

In the process of manufacturing butyl alcohol and acetone by the fermentation of corn, two American factories alone consume 25,000 bushels of corn a day. The result is the liberation of a mixture of hydrogen and carbon dioxide at the rate of 114,000 cubic feet a minute, and many experiments have been made to find a means of its utilisation. It is now reported that at Peoria, Illinois, a process has been developed for converting the gases into methyl alcohol, of which as much as 4500 gallons are obtained daily. The process is one of catalytic pressure hydrogenation of the carbon dioxide.

In his comments on the failure of a safety valve on board a vehicular ferry boat the Engineer Surveyor-in-Chief, Board of Trade, says:—"This cast iron safety valve chest had been in use for thirty-seven years, although the castng was somewhat defective originally by reason of blow-holes and sponginess not discoverable by external examination. The stress set up in making the joint and the effects of vibration when blowing off probably developed the weakness in the material at the defective part slowly, until under ordinary working stresses the chest fractured at the neck. A new chest with strengthening ribs at the neck has now been fitted.

A threshold type of experiment with numerous industrial possibilities was recently described before the American Electro-chemical Society by Drs. Lind and Glockler. Previous experiments of Dr. Lind with radio-active emanations acting on ethane or other hydro-carbon gases showed that ionisation resulted, one part of which brought about condensation and the formation of an oil. He then conceived the possibility of applying silent electrical discharges to the gases in the hope that similar results would occur. In the experiments referred to, electric fields were used instead of radio-active materials, and the results were very indicative of the occurrence of similar reactions.

The flood-lighting equipment for the new Eastern Entrance of the Canadian National Exhibition, which was supplied by the Canadian General Electric Company, Ltd., consists of fifty 1000-watt flood-lighting projectors. The combined beam candle-power of the flood-lighting installation is 3,375,000 candles. The projectors employed each consist of a galvanised sheet metal housing with a deep composite silvered and coppered glass reflector. They are equipped with a universal ball and socket focusing mechanism which permits adjusting in any direction, and employ the 1000-watt Mazda general service lamp. The front glass doors are equipped with lightly stippled lenses which soften the light and eliminate variations in the beams.

It has been decided to illuminate the Hanover–Berlin route to connect up with the Berlin–Königsberg route, which has been illuminated for night flying for some time. Other West German sections offering connections with more important routes will also be illuminated shortly. Illumination is effected by electric or acetylene beacons placed at close intervals. The lights, fixed on iron masts, are sufficiently close and brilliant to render each successive beacon visible from the preceding one, even in bad weather. In addition, special searchlights placed at greater intervals along the route enable the pilot to read his position. The beacon lights are arranged so as to be visible from all sides as well as from above, and special staffs are maintained to patrol the routes in case of a breakdown.

The biggest cargo lift with a ship's gear undertaken in Australian ports was, says the *Industrial Australian*, made a short time ago, when the Commonwealth cargo steamer Fordsdale discharged at Williamstown a hydraulic gap riveter weighing over 86 tons, consigned to the Victorian Railway workshops at Newport. Made by Fielding and Platt, of Gloucester, the riveter will be used for the "Pacific" class of boilers at Newport, and will ensure a great saving of labour. Nearly 40ft. in height, and possessing a 26ft. gap, it will be able to cater for all sizes of boilers. The machine will be built in a well, only 4ft. 6in. of it being above ground, and the boilers will be lowered into the gap by means of an overhead crane, the boiler being gradually lifted while the machine hydraulically rivets up the seam.

According to the *Chemical Trade Journal*, the Gross lead-coating process has recently been used in America to overcome some long-standing difficulties met in the construction of chemical plant where lead coating to resist corrosion is specified. The process is based upon a special formula flux which so prepares the surface of base metal as to promote the application of a thin, flawless, adherent coat of pure lead, upon which further layers of lead may be placed to any desired thickness by meansof the ordinary lead-burning process. The process has recently been employed on evaporator shells and covers, the manufacture of lead-lined tanks for pickling and plating and the manufacture of high-pressure steam coils for immersion in hot pickling solutions, &c. Employing the same process a new type of lead-lined drum has recently been approved by the Drum Committee of the American Manufacturing Chemists' Association and by the U.S. Interstate Commerce Commission, under Shipping Container Specification 7-A, for shipping and transporting sulphuric acid of all strengths, battery acid, electrolyte acid and hydrofluoric acid.

Miscellanea.

It is proposed to make an aerial survey of Tasmania.

A sulphur mine has been opened up at Tsaohokow in the Fengtien Province of China.

The recently started Spillers grain mill at Calgary, Alberta, has a capacity of 2000 barrels a day. The machinery is installed in a building ten stories high.

Work is about to be started on the exploitation of a deposit of diatomaceous earth at Digby Neck, Canada, which is said to contain over a million tons of material.

A 20,000,000 dollar merger of the steel and tin-plate companies of Northern Ohio is announced. This brings together sixty-one sheet mills producing 500,000 tons annually.

The Hollinger gold mine in Canada is now milling 6000 tons of ore, yielding 6·50 dollars per ton daily, and it is expected that the output will very soon amount to 8000 tons a day of 7·00 dollars ore.

At New Westminster, British Columbia, a proposal is being considered for the carbonisation of sawmill sawdust and mill waste in order to produce high grade charcoal for briquette fuel and poultry feeding.

At the Mill Close Leadmine, near Matlock, there has been found what is declared to be a remarkably rich section of ore below the 70-fathom level now under water. Pumping machinery is to be applied to remove the flooding of the level.

It is proposed to construct a dam across the Edward River, New South Wales, a few miles from Moulamein, to impound about 18ft. of water and provide a reservoir 27 miles long. The water will be used for irrigation purposes.

The pulp and paper industry of the Province of Quebec has developed remarkably since 1925, and the rated capacity of eight of the leading mills is assessed for the present year at 1,580,000 tons, or an increase in output of 75 per cent. in the two years.

The old mill at Back King-street, Bolton, where Samuel Crompton, the inventor of the spinning mule, first began to spin cotton commercially, in 1802, has had to be demolished in spite of efforts, during the last thirty-five years, which have been made to preserve it.

The Mukden Municipal Authorities have decided to establish a plant to manufacture coal tar for the asphalt roads in Mukden and other cities in Manchuria, which at present consume a total of over 100,000 dollars worth of coal tar every year. Half a million dollars have been voted for the capital of the plant.

Work has recently been begun on the new Wearmouth Bridge at Sunderland. Temporary girders have been laid upon the buttresses of the old bridge, which have been specially strengthened with steel work and concrete. They will form an overhead bridge, and will enable the cranes to be erected for constructing the outer portion of the new 375ft. span.

The German State Railways have, we understand, recently been making experiments with locomotives run on powdered fuel, the residual of brown coal after a process of low-temperature distillation. In order to safeguard their fuel supplies it is understood that the German State Railways are purchasing large brown coal deposits with a view to erecting coal distillation plants.

It is announced in *Canada* that the Hamilton By-Product Coke Ovens, Ltd., Ontario, has contracted with the Semet-Solvay Engineering Corporation, of New York, for the immediate construction of a complete plant for the manufacture of motor benzol. The Hamilton coke ovens plant recently doubled its capacity, and at present is carbonising about 1000 tons of coal every twenty-four hours.

Considerable interest is being manifested in the boring operations in progress at Lake Bunga, near Lakes Entrance, Victoria, and it is stated that the core gives unmistakable evidence of oil. In 1924 the Lake Bunga Development Company bored to 1200ft. where a strong flow of gas was struck. At a lower depth water caused a cessation of operations, but boring was resumed recently with what are claimed to be most favourable indications.

A company has been formed in Sydney, Australia, with a capital of £1,000,000, for the manufacture of Portland cement. The plant, which is to be erected at Medway, near Berrima, is to have an initial capacity of 120,000 tons a year. Subsidiary developments will include the equipment of a colliery, three miles from the site of the works, and the establishment of a central electric station for the requirements of the works, limestone quarry, and colliery.

The New South Wales Government has decided to grant a site for the erection of a building in Sydney, to be called Science House, to hold the offices of a number of learned societies. These include the Institute of Engineers, the Linnean Society, the Institute of Architects, the Dental Association, the Australian Chemical Institute, the British Astronomical Association, and the Royal Society, in which the site will be vested. The Societies will spend £50,000 on the work.

The new transmission line of the Shawinigan Water and Power Company, linking the Duke-Price hydro-electric development at Isle Maligne, on the Saguenay River, with the lines of the Quebec Power Company, has been completed and is now delivering power in the territory surrounding the city of Quebec. The new power line, over 100 miles in length, makes available 100,000 horse-power for the industrial activities which are taking place in the neighbourhood of Quebec City.

An important work now being undertaken by the Victorian Railway Department is the construction of a steel viaduct over the Maribyrnong River, near Melbourne. This viaduct will be a quarter of a mile long, weigh 1650 tons, and stand 180ft. above the deepest point of the river bed. The steel work is being manufactured by Melbourne engineering firms, but the erection of the bridge will be done by the railway construction staff. Work was commenced in March this year, and the programme of operations is laid out to finish in 1929.

ERECTING CRANE EQUIPMENT FOR SYDNEY HARBOUR BRIDGE

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This Supplement, which deals with the Science of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

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TWO-PAGE SUPPLEMENT—CRANE EQUIPMENT FOR ERECTING THE SYDNEY HARBOUR BRIDGE.

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The Metallurgist

THE OCTOBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

DEATH.

ON October 20th, at Middlesbrough, ALEXANDER TERTIUS HARVEY, managing director of the Anderston Foundry Company, Ltd.

THE ENGINEER.

OCTOBER 28, 1927.

Metallurgy and Engineering.

IN his Presidential Address to the Institution of Mechanical Engineers, on Friday evening last, Sir Henry Fowler dealt in a particularly interesting way with the dependence of engineering progress on the progress of science in other fields. A great portion of the address was, however, occupied with the influence of metallurgy, and especially of metallurgical research, on mechanical engineering. This is, of course, a matter with which we have dealt repeatedly in these columns, and the very existence of our monthly Supplement, THE METALLURGIST, is a recognition of the point emphasised in Sir Henry's address. It is, however, particularly gratifying that an engineer of the eminence of the President of the Institution of Mechanical Engineers should make an appreciation of metallurgical research the keynote of his address, and metallurgists engaged in research—whether in the Universities or the National Physical Laboratory or in the research laboratories of industry, will be grateful to Sir Henry for words which not only furnish strong encouragement to them in their work, but much-needed support in their efforts further to extend and develop their activities.

The Institution of Mechanical Engineers has, in the past, done much to foster metallurgical research, and the President was able to point with pride to the long list of "Alloys Research Reports" which were the result of the encouragement and support given by the Institution. This work was particularly valuable in the early days when metallurgical research was still in its infancy. Turning back to the discussions which took place on some of the first of these "Alloys Reports," one can find doubts recorded, for example, as to the value of the methods of metallography, and, particularly, of microscopic work on metals, on the ground that only a pin point of metal could be examined and that it was not safe to draw conclusions affecting tons of material from a study of minute particles. This apparently "common sense," but in reality unsound, criticism has long since died away, and the recognition of the microscope as an indispensable tool of the metallurgist—and, through him, of the engineer—is now universal. It is curious, however, to find Sir Henry Fowler still slightly troubled by this view, as he directs attention to the fact that the areas represented by highly magnified photo-micrographs are extremely minute and urges the use of "macroscopic" methods. On this point we agree with him entirely in regard to the value of macrographic examination, a method whose great importance is receiving steadily growing recognition. But it may be worth while to point out that while the area represented by a single photo-micrograph is extremely small such a photograph is, or should be, merely a typical representation of what is observed over a much larger area of section. A careful metallurgist will not take a photograph of a particular point of his specimen until he has satisfied himself by visual examination under the microscope that it is truly typical of the whole area of section available to him—and this should be an area of something like half a square inch. Sometimes, indeed, several such specimens from the same piece of metal will be carefully examined, so that the photo-micrograph may safely be regarded as a typical representation of the structure of quite a reasonably large sample of metal. This use of typical specimens, however, is by no means confined to microscopic examination. Chemical analysis is universally accepted as furnishing reliable data, and yet the quantity of metal used in many analytical processes is only half a gramme—again only a minute fraction of a forging or, still more, of a cast of steel.

The main point of Sir Henry's address, however, relates to much larger issues than these. Perhaps its chief value lies in the fact that it is a generous admission, by the typical user of metals, of the value and need for metallurgical research both in industrial laboratories, in the Universities, and in the National Physical Laboratory. This appreciation is of value in itself, but should bring about an equally generous support of such research from the great companies and organisations whose existence and progress is so intimately concerned with metallurgical advance. Unfortunately, the user is; too often, inclined to take the view that metallurgical progress is entirely the affair of the producer of metals, and that if the user tells the metallurgist "what he wants" it is for the metallurgist to produce it. But if, as Sir Henry Fowler clearly showed, engineering progress is so closely related to metallurgical research, it is surely not too much to ask that engineering firms and institutions should bear some of the burden of such research. And it must be remembered that the cost of metallurgical research is far greater to-day than it was even thirty years ago. As knowledge progresses, methods of increasing refinement have to be employed in the endeavour to extend the boundaries of that knowledge. The advances of physics and chemistry are constantly placing new tools in the hands of the metallurgical investigator. These new methods supplement but rarely supersede existing methods and apparatus, so that a greatly increased armoury of appliances is required in the modern metallurgical laboratory, and with this goes a human equipment of greater diversity as well as a higher degree of skill and knowledge. If such resources are to be fully utilised, metallurgical research will have to be more adequately supported financially in the future than it has been in the past. There could be no stronger appeal for such support from all those concerned with the use of metals than Sir Henry Fowler's presidential address.

The Industrial Engineer.

THERE is a school of thought, or perhaps it would be better to say, a school of opinion, which looks to super-stations, "grids" interconnection systems, and all the paraphernalia of wholesale electrical development to solve the question of industrial power. The supply of power to factories, it is argued, is a technical business, and therefore best left in the hands of the power companies which have at their disposal plant and knowledge which the ordinary factory manager cannot hope to possess. The man whose business in life is to

produce textiles, wall-papers, jam or whatnot, cannot possibly be an expert in power production, and even if he were, he would find it cheaper to get rid of his little private power plant with all its worry and expense, and purchase the power he wants from the nearest central station. The argument is plausible, and there are many cases when it is true. But it is by no means so self-evident as some people may pretend. The private plant supplying a factory is burdened with no transmission costs, the capital charges are low, while its supervision and labour make no appreciable difference to the factory expenses. Even though the fuel costs may be double or treble those of a central station, it may be cheaper on the whole to incur them than to purchase power. When steam is required for heating or process work it is usually exceedingly difficult to make out a case for the purchase of power. By using the steam first in an engine or turbine, before letting it pass away at a comparatively low pressure into the heating system power is obtained, if not for nothing, at any rate at a price with which no outside supplier could hope to compete. Private plants, of which there are altogether many scores of thousands in the country, range all the way from those which it would pay to shut down at once, to others which give a much more economical service than could be obtained from any power company. The factory manager, when approached by some one who would sell him power, rarely knows what he really ought to do. Conservatism and a liking for independence argue in favour of the maintenance of his own plant, but then the power canvasser is so plausible and seems so sure of his ground! Possibly while the question is pending another traveller comes along and holds out prospects of enormous economies if only a new kind of feed-water regulator, or fire-brick or CO_2 meter is installed. The manager, doubtful of his own judgment in a business he does not understand, usually without exact costs of his present method of producing power, and harassed by advice from people who have something to sell, is at least as likely to come to a wrong decision as a right one. Wrong decisions are certainly made every day. Plants are shut down when it would be cheaper in the end to remodel them or improve their operation, than to purchase power, while others are kept going out of costly ignorance.

What is the remedy for this state of affairs? In an interesting paper entitled "The Industrial Engineer," read recently before the Institution of Engineers and Shipbuilders in Scotland, Mr. A. J. T. Taylor pleads for the development and recognition of a special class of engineer who should be experts in all questions that bear on the supply of power and heat in factories. The "industrial engineer," he holds, might render immense service to British industry, especially in textile mills, sugar refineries, breweries, dyeworks, and other large steam or power-using establishments. He must be much more than a combustion expert, for the efficient production of steam, or even of power, is not enough. He should realise that these matters are but means to an end, namely, the most economical operation of the processes which use the power or heat produced. A thorough knowledge of the manufacturing methods in any given industry would be necessary to him, so that he could arrange for the best overall combination of the possibilities of the power plant with the demands of the factory. If thermal storage, for example, would pay he would be in a position to say so and to give an estimate of the cost and savings of a suitable apparatus. If more power were required, he could tell exactly the maximum price at which it would pay to purchase it. He would be able to tell the manager exactly at what cost the factory was producing its power, and to estimate, as far as anyone could estimate, what he would have to pay per unit under such a tariff as, "a rental of £1 per kilowatt per quarter of the consumer's demand, subject to a minimum payment in respect of any quarter's kilowatt demand equal to 50 per cent. of the previous highest quarterly payment in respect of the kilowatt demand." To this must be added "a unit price of ·55 of a penny per unit for all units up to 25 per cent. load factor; and ·45 of a penny for all units in excess of 25 per cent. load factor, subject to an increase or decrease of ·0054 of a penny for each 3d. rise or fall in the cost of coal per ton delivered into the electricity works bunkers above or below the price of 18s. 6d." This, we may say, is no imaginary tariff, but is quoted verbatim from a list of charges with which factory managers are confronted in one large town in England, and from which presumably they are expected to learn what power will cost them if purchased from the municipal supply. Besides acting as interpreter in cases like the above, the industrial engineer, from his knowledge of manufacturing processes as well as of steam engineering, would be able to tell whether any re-arrangement of processes which would benefit the power plant would be practicable from the factory point of view. He should, indeed, in Mr. Taylor's scheme, not only have the supervision of the design and operation of industrial steam plants, but also have the right to an audible voice in the organisation and conduct of all the processes which depend on steam and power for their economical working.

That really competent control of the power and heat supply to most of our non-engineering factories would often result in large economies, there is not a shadow of a reason to doubt. In cotton mills it has been the practice for a generation or more for the engineer to make a weekly return of the coal burnt per I.H.P. hour, but what is really wanted is a comparison, week by week, or from factory to factory, of the coal burnt per pound of cotton manufactured. Similarly in other industries, it is the fuel or power per unit of saleable product which is the thing to watch. It was stated some years ago in a discussion before the Institution of Engineers-in-Charge, that the coal consumption varied, from brewery to brewery, from 30 lb. to 134 lb. per barrel of beer brewed. Everybody knows that there is "beer" and "better beer," but surely it is rather inefficiency of operation than quality of liquor which makes one brewery require four and a-half times as much fuel for the same output. The almost incredible conditions which sometimes prevail may be indicated by a case which came under our personal notice some time ago. A steam engine, also in a brewery, was running with the cylinder cocks wide open, and on inquiry we found that it had been doing so continually since it was first started some ten years previously, owing apparently to a misunderstanding of some advice given by the erector. The escape of steam was not obvious, as the cocks were piped to a drain, but the mere act of closing them at once resulted in a visible gain of speed of the engine. We do not pretend that operation of this kind is typical of industrial plants, many of which are in the charge of very competent men. In others, however, so long as sufficient steam and power and light are available, nobody knows or cares very much at what cost they are produced. This is really at the root of the mischief. There is little hope for any general improvement until factory managers begin to wonder whether their efforts for economical production are not being hampered by avoidable losses in their engine and boiler-rooms and in their heat-using processes. Once aroused to this possibility and wise enough to know that for an ordinary workman's wages they cannot expect more than an ordinary workman's knowledge, there will be a demand for industrial engineers of the type Mr. Taylor has in mind. "Boards of directors," he says, "and especially managers, count more for or against industrial efficiency than all other influences combined." It is a striking assertion and a true one. The responsibility for the inefficiency of any department of a business ultimately rests in the board-room. It is there that power costs ought to be discussed with knowledge, and it is there that a policy of controlling them, suitable to the factory in question, should be decided on. It is probable that in any factory where a saving of anything more than 10 per cent. of the cost of fuel would pay the salary of a good engineer, such a man should be engaged without hesitation, for few indeed are the industrial plants where a capable man with reasonable freedom of action could not save far more than that sum.

Institution of Electrical Engineers.

PRESIDENTIAL ADDRESS.

In his presidential address, which was delivered before the Institution of Electrical Engineers on the 20th inst., Mr. Archibald Page, after a short reference to the present condition and activities of the Institution, went on to give an outline of the history of electricity supply in this country. He showed that the first instance of the public supply of electricity was given in 1881, when the power of the river Wey was used to light the streets of Godalming in Surrey. He then reviewed, first of all, the passing and effects of the Electric Lighting Acts of 1882 and 1888, and then the findings of the Board of Trade Inquiry, which was presided over by Major (afterwards Sir Francis) Marindin. That Inquiry, which was ordered as the result of so many competing applications for Provisional Orders being received, Mr. Page described as being the first of the many attempts that have been made to settle the electricity supply of London on rational lines. At it, he explained, the point round which the greatest controversy raged was whether it was better to adopt direct or alternating current for distribution. Comparatively little was said about the question of competition, or about the size of area, and there was not a word about frequency or the desirability of having a uniform pressure at the consumers' terminals. Dr. Ferranti's scheme of supplying a large area from Deptford was, however, subjected to much criticism.

As the outcome of the inquiry, went on Mr. Page, Major Marindin expressed himself as being wholeheartedly in favour of encouraging any experiment that was likely to be for the public benefit. He equally emphatically upheld the proposal to supply large areas from one station. Nevertheless, competing powers were granted, where they were sought, provided that one system was alternating and the other direct current.

Mr. Page then proceeded to say that towards the end of last century experience began to show that Dr. Ferranti had been correct, though the general Acts formed a bar to development on the lines suggested by him. In 1898, therefore, four Bills were promoted which contained proposals so far-reaching that a Select Committee of both Houses, presided over by Lord Cross, was appointed to report upon them. This body expressed itself in favour of the grant of the wider powers sought. These included the compulsory acquisition of land on which to erect generating stations, security of tenure, the right to supply over large areas for bulk and power purposes, and facilities for laying mains through intervening territory.

It was presumed that general legislation would be introduced to give effect to these recommendations, but, in fact, nothing was done until 1909. Then, owing to the conflicting views of the parties concerned, the measure—the Electric Lighting Act, 1909—was so emasculated that much of the usefulness of the original Bill was destroyed. Prior to this, however, a number of Bills had been promoted by the undertakings which we had now come to know as power companies. Most of these were dealt with by a committee, of which Sir James Kitson was chairman. The outcome was the formulation of what are now known as the "Kitson clauses." These governed the operations of the companies in the areas of the then existing authorised undertakers which were situated within the power companies' boundaries, their main object being to limit competition by the power companies in the other authorised undertakers' areas without the latter's consent, which consent was not to be unreasonably withheld.

As usual, many variations in the shape of protective clauses were inserted in these special Acts. That was one of the evils of private Bill legislation—a procedure which, as far as electricity supply was concerned, had otherwise much to commend it—for though the clauses which embodied such restrictions were not theoretically precedents, they had that effect in practice.

In 1905, another attempt, the first of a series, was made to solve the problem of electricity supply in London. In that year the Administrative County of London and District Electric Power Company sought powers to supply over an area comprising the administrative county and the surrounding districts. In that way it was hoped to give the Metropolis cheaper electricity than the existing undertakings could provide, and to ensure large consumers the same advantages as were obtainable in the provincial power companies' areas. Had that Bill been passed, as it nearly was, the history of electricity supply in London would have been very different from what it had been.

Subsequent years were marked by a series of Committees and abortive Bills, all of which enshrined the principle of one large and inclusive scheme for London. But tangible result there was none, except that the London Electric Supply Acts of 1908 and 1910 transferred the rights of purchase of the metropolitan company undertakings from the local authorities to the London County Council.

Mr. Page then showed how the outbreak of the war and the subsequent increased demand for power exposed the weaknesses of our electricity supply policy. Evidence to show that the interconnection of existing generating stations was well worth while and was not, he said, long in forthcoming, and at the instigation of the Board of Trade, Linking-up Committees, consisting of representatives of the authorised undertakers concerned, were set up in several districts to investigate what could be done in that direction by voluntary effort. There was some practical result, but it was evident that something more was necessary, and in 1917 the Board of Trade appointed the Electric Power Supply Committee, under the chairmanship of Sir Archibald Williamson—now Lord Forres.

The report of that Committee, the recommendations of which, said Mr. Page, marked the genesis of the reorganisation on national lines which was now in progress, included the important statement "that the parochial system of generation and distribution should give place to more economical methods involving wider areas of distribution." The unanimous conclusion of its members was that one central authority, to regulate the generation and distribution of electricity, was required, and it was suggested that a body, to be known as the Electricity Commissioners,

should be appointed for this purpose. The country was also to be divided into districts, in each of which a Board was to be established. This Board was to acquire all the generating stations in that district and also to be responsible for their operation. Soon after the war ended these recommendations were embodied in a Bill, which the Government introduced in the session of 1919. This measure was, however, considerably amended in its passage through Parliament. The provisions relating to the appointment of District Joint Boards and to the compulsory acquisition of generating stations were struck out and new clauses providing for the setting up of Joint Electricity Authorities, with powers to acquire generating stations by agreement, were substituted. In this form the Bill became the Electricity (Supply) Act of 1919, which was later supplemented by the Electricity (Supply) Act of 1922.

The Electricity Commission was in active operation by the spring of 1920, and up to the end of 1924 fifteen districts had been provisionally delimited and many reorganisation schemes of varying nature and scope had been submitted for consideration. Progress, however, was painfully slow, owing to the conflicting interests concerned. The fact was, the industry as a whole did not take kindly to the Joint Electricity Authority idea. There was a want of faith in the ability of these bodies to solve the problem set them, and, except in special circumstances, such as obtain in London, North Wales, the West Midlands and North-West Midlands, there was almost a complete lack of any enthusiasm and a great deal of antagonism. Advisory Boards had been useful, but, as their name implied, their scope was limited.

Little was done, therefore, towards centralising generation, and eventually a Committee, of which Lord Weir was the chairman, was appointed in 1925 to report on the policy that should be adopted to ensure the most efficient and effective development of the supply of electrical energy. That Committee recommended the establishment of a system of main transmission lines, designated the "grid-iron," for the purpose of interconnecting the principal generating stations throughout the country in which the generation of all the supplies required by authorised undertakers was to be concentrated. It also recommended the setting up of a Central Electricity Board, which was to be responsible both for the erection of the "grid" and for the operation of the stations "selected" to feed it. Further, it proposed that the frequency should be standardised throughout the country. These proposals, and most of the others made by this Committee, were embodied in the Electricity (Supply) Act of 1926.

The next portion of Mr. Page's address was concerned with the growth of the consumption of electricity in this country from the commencement, and he exhibited a curve which showed most conclusively how great and rapid had been the increase of consumption, especially during recent years. Nevertheless, he said, we had been arraigned, time and again, on the charge that our consumption of electricity per capita was too low. The indictment was that America, Scandinavia, and Switzerland consumed about 500 units per head of population, while Great Britain only consumed 125 units. The deduction to be drawn from those figures, *i.e.*, that we were unenterprising as compared with other countries, was, he urged, less than just. It took no account of the differences in the national and physical conditions of the respective countries, though they bore materially upon the situation.

In explaining why so much less electrical energy was used in this country than in others, Mr. Page said that it was the fashion to attribute all our electrical ills to "restrictive legislation," but, making all due allowance for the earliest Acts which had undoubtedly retarded matters, and for provisions in subsequent general Acts, which had obstructed development, he was forced to the conclusion that legislation was not the primary cause, either of the inception or of the continuance of generating electricity piecemeal. The fact was that rivalry between the large undertakings and an over-zealous display of local patriotism by the smaller municipal undertakings were the real reasons for our persistence in out-of-date production. We must, therefore, accept responsibility in so far as the consumption per capita had been adversely affected in the past by there being too many generating stations, most of them small and inefficient.

But other factors affected the situation. As was well known, we were blessed with widely scattered coalfields and an extensive coast line, which facilitated cheap conveyance. It was not too much to say that that combination had dominated the whole situation. Then, again, there was no country in the world in which the gas industry was so fully developed as it was in Great Britain. There were, asserted Mr. Page, 8,700,000 consumers, with 6,000,000 gas cookers on hire, and the claim was made that gas was available for, and used by about 95 per cent. of the population. The fact that it accounted for 9 per cent. of the total coal used supported that claim and was a proof that gas played a considerable part in the scheme of things. That was sometimes forgotten by our critics. Again, factories were established much earlier in Great Britain than elsewhere, and, with cheap coal available, their power requirements were so well met that by the time electricity became a competitor the case for changing over was in many instances so poor that the additional capital expenditure on new equipment could not be justified. Still, the old steam plant, which in textile mills was invariably of the Corliss valve type and therefore efficient, had now in large measure run its course and the electric drive was superseding it wholesale. The turn of the tide was, in fact, so definite that a long-established firm of Corliss engine makers had recently decided to go out of the business, although it possessed ample funds with which to carry on.

"I think," continued Mr. Page, "it is generally agreed by those who have investigated the position, that there are many reasons why electricity consumption, both in America and in countries possessing ample water power resources, should be greater than with us. America's industrial organisation was hardly affected by the war; her income per head of population is about twice as great as ours; the speeding-up of the industrial machine is welcomed in a way which is not the case here; the scarcity of domestic labour—now, alas, becoming painfully evident nearer home—has caused the multiplication of labour-saving devices; her population has grown rapidly and many new houses have consequently been built; and electric traction has spread. These factors have all combined to accelerate the growth of the output of electricity, in spite of the fact that the price is not less than that charged in this country. In the cases of Scandinavia, Italy, Switzerland, and France hydro-electric power has taken the place of coal, because the latter has to be imported at high prices and, the gas industry not being extensively developed, electricity has therefore advantages which far exceed those of any other power or lighting agent. Extra high-tension overhead transmission lines are a necessary part of such systems, and public opinion has expressed itself very effectively in the direction of removing many of the disabilities which militate against their use in Great Britain.

"A comparison with foreign countries is useful and periodically necessary, but our own problem, as has been shown, has its own special characteristics. To say that, because one country consumes five times as much electricity per capita as another, its workers have five times as much power at their disposal, requires qualification. In fact, after allowance has been made for the water power utilised, the coal and oil consumptions per capita constitute a more reliable method of estimating the amount of power available than does the electrical consumption.

"Knowing the spirit of enterprise and emulation, which exists in the supply industry as it is constituted to-day, I am, therefore, in no way depressed or disturbed by these comparisons. Centralisation of generation has, it is true, been somewhat delayed. Nevertheless, there has been nothing akin to stagnation in the production of electricity, as is shown by the fact that the output during the last five years has increased by 54 per cent., and although the 1919 Act has not brought the 'rare and refreshing fruit' that was promised, a great deal has been learnt and, I confidently assert, digested.

"There is no infallible remedy for the present state of things, but it is essential that our methods of generation should be altered and, to enable us to effect this alteration, a system of E.H.T. lines interconnecting the various stations must be established."

Mr. Page then showed illustrations of the double and single-circuit towers which had finally been decided upon by the Electricity Board, in consultation with Sir Reginald Blomfield, R.A., for the 132,000-volt transmission lines. He also, with the permission of the Electricity Commissioners, reproduced a map of the country on which was drawn the approximate routes to be followed by the "grid" of proposed lines, though not, of course, the extensive secondary network that would be required. Then, after a brief discussion of the question of frequency standardisation, and of the costs of the change-over, of transmission and distribution, the President dealt in more detail with the "grid" itself. As the water power available in the British Isles was relatively small, the great bulk of our electricity must always be derived from coal. Between the Grampian Hills and the English Channel no part of the country was more than 100 miles away from the nearest coalfield and very little of it was more than 50 miles distant. Our extensive coast line was a factor of supreme importance, as, owing to the cheapness of water transport and to the fact that dock dues and terminal charges constituted a substantial portion of the cost of conveying coal from the mine to the generating station, coal could be bought as cheaply on the lower reaches of the Thames as on the Tees. The price of coal in individual coalfields throughout the country varied from year to year as compared with the yearly average, the variation depending on local trade and the demand elsewhere for different classes of coal. It was estimated, however, that over a series of years the price of the class of coal used in properly sited power stations would not vary by much more than 10 per cent. between one station and another.

That being so, the main function of the "grid" would not be to transmit large blocks of power continuously over any great distance in one direction. In a country the natural characteristics of which were those of Great Britain there was no necessity for long-distance transmission, in the sense that that term was understood in countries with large water powers or extensive brown coal deposits.

The value of the "grid" would lie rather in the following directions:—

(*a*) It would constitute, with the selected stations, a complete system for the production and transmission of electricity on a wholesale scale and thus enable full advantage to be obtained from the diversity of loads, from the correct apportionment of the total load between stations of varying efficiency, and from the elimination of obsolete and unsuitable plant.

(*b*) It would enable the capital cost per kilowatt installed in the selected stations to be kept down.

(*c*) It would be possible for these stations to be correctly situated away from the centres of population.

(*d*) It would enable individual stations of larger output than would otherwise be possible to be employed, and extensions to be co-ordinated in accordance with a plan.

(*e*) It would allow the aggregate amount of spare plant to be considerably reduced.

(*f*) It would enable "blocks" of waste heat or energy from blast-furnaces, coke ovens and other sources to be transformed into electricity and thus usefully employed.

(*g*) It would level up (without levelling down) the efficiency of generation throughout the country.

(*h*) It would permit our water power resources to be tapped, and thus supplement the energy from coal in a more complete and less costly manner than would otherwise be possible.

(*i*) It would facilitate railway electrification by reducing the capital cost of the necessary transmission lines, as the "bars" of the "grid" would follow the railway routes to a considerable extent.

(*j*) It would reduce the cost of secondary or regional transmission by increasing the number of points at which the supply could be taken; and, for the same reason, it would encourage the opening up of new areas of supply in rural and agricultural districts.

(*k*) The Chancellor of the Exchequer in his last Budget speech had said that there was some indication that the centre of gravity of industry was moving south. The "grid" would facilitate the development of industry in any part of the country which was otherwise suitable.

So much for what the "grid" might be expected to do.

On the other hand, there was a number of things which it would not do and, considering the extraordinary predictions that had been made, it was as well that those should be clearly stated:—

(1) It would not, as such, appreciably improve the efficiency of generation in the areas of certain of the electrical power companies and larger municipalities.

(2) It would not reduce the price of electricity for lighting in our big cities. For that matter no possible improvement in production methods could do much in that direction, since the charges on the capital expended in giving the service were the preponderating factor which controlled the price of low load factor supplies such as lighting. Those were naturally high in towns, owing, among other reasons, to the high cost of the distribution system as a consequence of the expense involved in breaking up and reinstating modern streets.

(3) It would not create a new electrical heaven, or "give ninepence for fourpence."

The "grid" would, however, go a long way towards ensuring the universal availability of electric power throughout the country. Although it would take some eight years to complete, the result of its establishment in some districts should be noticeable within two to three years.

The one thing which was essential to ensure success in this direction was co-operation, and that co-operation must be founded on confidence between all the parties concerned. To enable that co-operation to be brought about, there must be a minimum of interference with the work of authorised undertakers, a maximum absence of formality, and a sound, sane business policy.

The general increase in Canada in 1926 as compared with 1925 in the hardware and tools production industry is the subject of a report just issued by the Dominion Bureau of Statistics. Production in 1926 was valued at 22,829,695 dollars, an increase of 28 per cent. over the 17,882,650 dollars reported for the previous year, which, in turn, was 15 per cent. over 1924. Increases were recorded in nearly all branches of the hardware and tools industry, the largest individual increase being in the manufacture of razor blades, which increased from 21,455,556 blades in 1925 to 63,664,221 blades in 1926. The largest percentage gain was in motor car accessories, which practically quadrupled in 1926 at 944,605 dollars, compared with 246,567 dollars in 1925. There was an increase of more than half a million dollars in the value of production of bolts, nuts and rivets in 1926, and a similar increase in locks and other builders' hardware. In that year there were 123 plants in Canada engaged primarily in the production of such commodities as bolts, nuts, rivets, screws, razors, cutlery, forks, hoes, saws, rakes, axes, machine knives, and tools, dies, drills, wrenches, &c.

THE FERRYBRIDGE ELECTRIC GENERATING STATION

MR. W. B. WOODHOUSE, M.I.E.E., LEEDS, ENGINEER

(*For description see opposite page*)

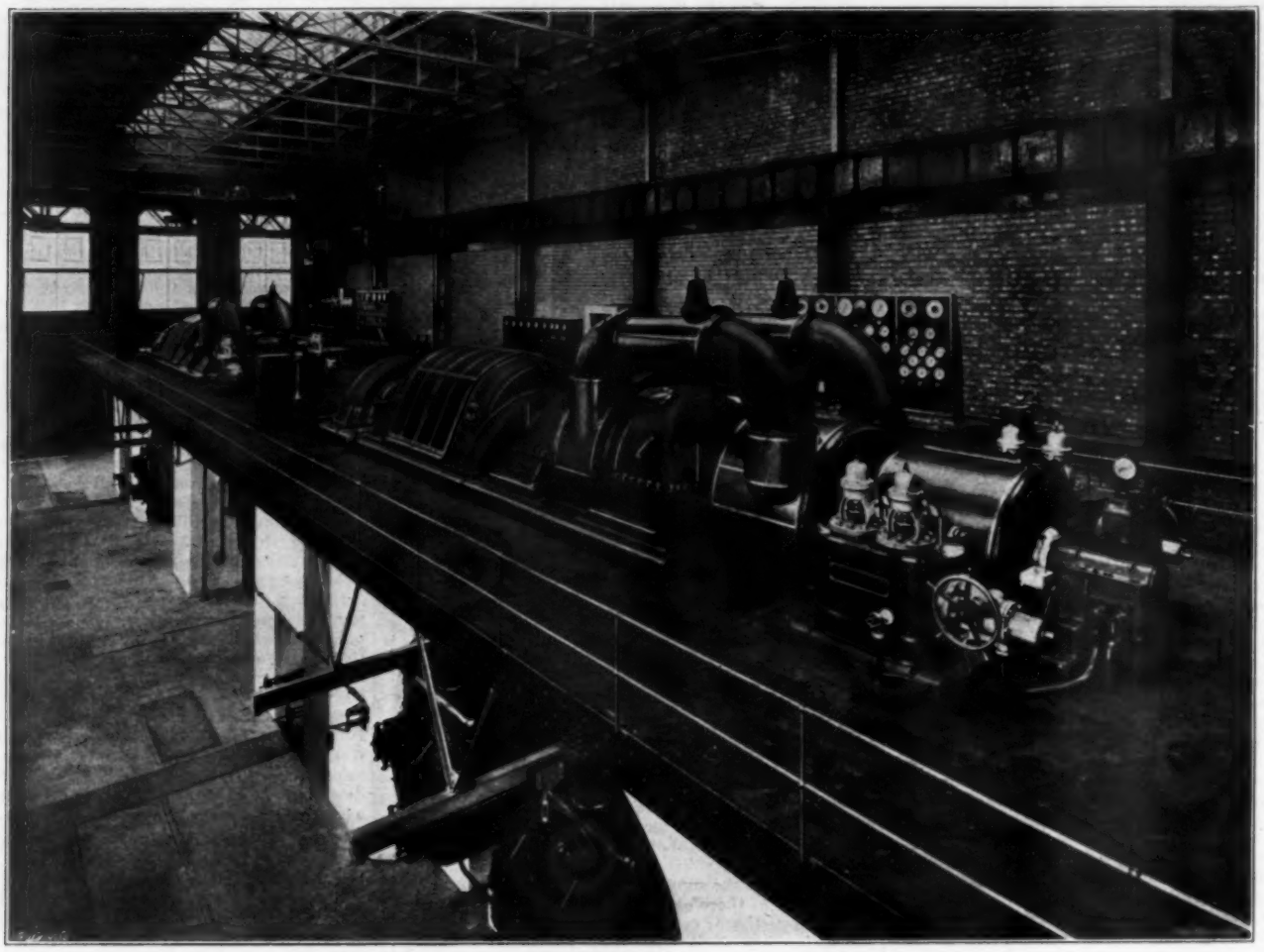


FIG. 1—INTERIOR OF TURBO-GENERATOR HOUSE

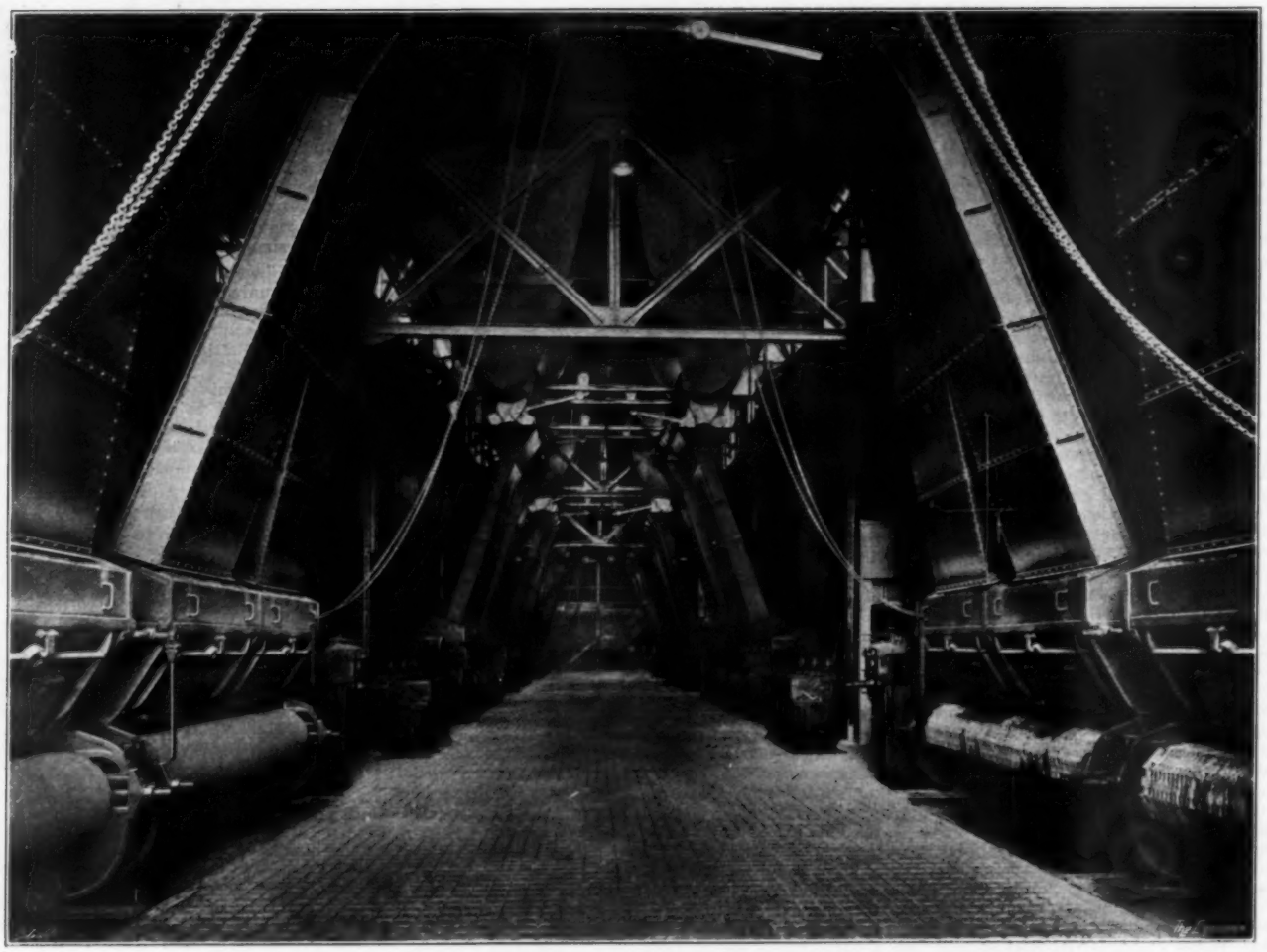


FIG. 2—INTERIOR OF BOILER HOUSE

The Ferrybridge Station of the Yorkshire Electric Power Company.

No. I.

The first section of the new Ferrybridge Generating Station of the Yorkshire Electric Power Company has recently been completed and put to work, and we were invited to inspect it a few days ago.

The company was established in 1901 by an Act of Parliament which, among other things, authorised the supply of electricity over an area of approximately 1800 square miles in the West Riding of Yorkshire. Arrangements for supply exist between it and the Corporations of Barnsley, Bradford, Keighley, Leeds, Rotherham, Sheffield, and Wakefield, and it furnishes current in bulk to the Coporations of Batley, Brighouse, Dewsbury, Pudsey, and Todmorden, as well as to various Urban District Councils and other local authorities, &c. The revenue from the sale of current during the year 1925—the latest figures to which we have access—was nearly £440,000, and the percentage of working costs to revenue from the sale of current was 58·78. Altogether it is a prosperous and progressive undertaking.

The company supplies the power requirements of many important industries, such as collieries, woollen and other textile mills and factories, steel works, shipyards, chemical, glass and brick-works, &c. Electricity is used in collieries for such purposes as winding, pumping, ventilating, coal cutting, coal washing, haulage and lighting, and many of these uses provide a day and night load for the company's plant. Several agreements have also been entered into by the company for the interchange of surplus energy with collieries which have generating plants of their own. Another branch of the company's business, which is of growing importance, is the supply of electricity for public utility purposes, such as street lighting and the operation of sewage works. At any rate, the demand for current had been growing consistently for a number of years prior to 1917, when, in spite of the fact that help had been received from outside sources, it was felt that the time had arrived when it was necessary to establish a new principal generating station.

It may be here explained that the company commenced operations in 1905 from the Thornhill Station, which is equipped with B.T.H. and Parsons turbo-alternators supplied with steam from Babcock and Wilcox, Clayton, and Stirling boilers. This station was extended several times, until its capacity became 54,380 kVA. Subsequently the Barugh Power Station was erected. It has a capacity of 20,000 kVA and contains B.T.H. and English Electric turbo-alternators with Stirling and Clarke-Chapman boilers. There is also the Thorne Power Station, from which energy purchased in bulk from outside is distributed. The company has nearly 400 miles of Callender three-core paper-insulated, lead-covered cables and nearly 300 miles of overhead transmission lines. Three-phase, 50-cycle current is employed, the transmission voltage being 33,000. It is distributed at 2000 volts and 400 volts for power and at 230 volts for lighting.

By the courtesy of Mr. W. B. Woodhouse, M.I.E.E., the engineer and manager of the company, we are enabled to place the following information regarding the newest development of the undertaking before our readers.

The site of the new station at Ferrybridge, near Knottingley, was only decided upon after long and careful consideration. It was necessary, of course, to combine to the best advantage an abundant supply of water, with plentiful and cheap fuel. The latter requirement naturally involved proximity to collieries and ready means of transport. It would have been hard to choose a better site, from every point of view, than that at Ferrybridge. It has an area of 135 acres and the initial section of the station is built on the easterly side of the site. It covers an area of some 32 acres, and passing close by is the Great North Road, which crosses the river Aire at this point. There is an extensive frontage to the river, which drains a large area in the West Riding, while some few miles above Ferrybridge it receives the waters of the river Calder, which also has a wide gathering ground. The combined stream has, where it passes the new station, a width of some 180ft. and a depth of about 14ft., and its volume is ample, so we understand, for supplying the circulating water needs of the station even when the latter is enlarged to its final designed capacity.

For fuel the great Yorkshire coalfield will be drawn upon. It already has an annual output of 45,000,000 tons, and in view of the present extent and probable future development of this source of supply, it is considered that the station is so favourably situated in respect of facilities for transport—both by railways and waterways—that the cost of fuel delivered to it will be little greater than the cost at the pit mouth. The waterways of the Aire and Calder and other navigations enable coal to be brought by them from South and West Yorkshire in barges of up to 250 tons capacity, and if the alterations to certain locks, which are in contemplation, are carried out, they will allow of barges of at least 400 tons burden to be employed.

As regards rail transport, a line of the London and North-Eastern Railway passes some 250ft. or so from the station buildings, and is in direct connection with extensive sidings which have been laid down by the Power Company.

There is ample provision therefore both of water and of fuel, and the company has taken care to avail itself fully of these advantages. It has constructed a well-equipped wharf on the river bank and it has designed its coal-handling plant so that railway wagons of up to 20 tons capacity can be dealt with.

Before going on to describe the equipment in detail we may, perhaps, first of all give a general description of the station buildings, a view of which is given in Fig. 3. If only those disfiguring chimneys could have been omitted it would have been, if not quite a handsome, at all events a really dignified, structure! Indeed, even the chimneys cannot entirely deprive it of its dignity, which is probably due to the columnar effect of its subdivided side walls. Certainly a special feature of the design is the large window area, which not only provides an exceptional amount of natural lighting, but also provides for thorough ventilation. The subsoil on which the building has been erected consists of sand and gravel on which alone it was considered unwise to rely for the foundations. However, at a by no means prohibited depth there is a deposit of the lower magnesian limestone, which, in the Ferrybridge area is a compact dolomitic rock. It was therefore decided to resort to piling. Reinforced concrete piles were used and they were driven down to depths ranging from 20ft. to 43ft. They were arranged in groups at places where the greatest loading was to come, as, for instance, under the machine foundations, &c. Connecting the heads of all the piles together there is a continuous raft of reinforced concrete, which forms the floor proper of the building. The raft varies in thickness, the depth being increased at points of heaviest loading. Actually speaking, the raft does not form the working floor, for since the site is low and level it was found convenient to introduce a further floor 4ft. 3in. above the top of the raft, and to use the intervening space to accommodate pipes, cables, &c., an arrangement which has the advantage of leaving a clear operating floor.

The superstructure consists of a steel framework enclosed by brick panels, with terra-cotta enrichment, the whole being protected by a reinforced concrete roof supported by steel trusses. The structural steel work was supplied by Heenan and Froude, Ltd., of Manchester, while the general building work was carried out by the Foundation Company, Ltd., of London. The main building is divided into three sections. First of all, at the south side there is the office and workshop accommodation, then to the west there is the turbine house, the boiler-house coming to the east. The turbine and the boiler-house have both been designed for extension, endwise, for the reception of additional plant when it becomes necessary to install it.

It has now become quite usual to arrange the main switchgear of large generating stations in a separate structure, and at Ferrybridge we find that it is contained in a building erected some little way from the station and between it and the railway. The switch-house is itself a fine-looking building, and is quite in keeping with the main station, the two together forming an unsually attractive combination of structures.

A view looking along the wharf is given in one of the accompanying half-tone engravings. The wharf, which is constructed of reinforced concrete sheet piling, combines provision for the moorings of barges during unloading and also for the discharge of the circulating water. The view also shows the electric jib crane which is used for unloading the barges, as well as the tippler for dealing with the coal wagons. As we propose to discuss the coal-handling plant in our following article, we will say no more about it at present, but turn to the question of circulating water. The intake works are arranged some 550ft. upstream of the wharf. They consist of culverts formed beneath the tow path through which the water flows, to vertical disc screens on its way to the circulating pump sumps, preliminary screens of steel bars being

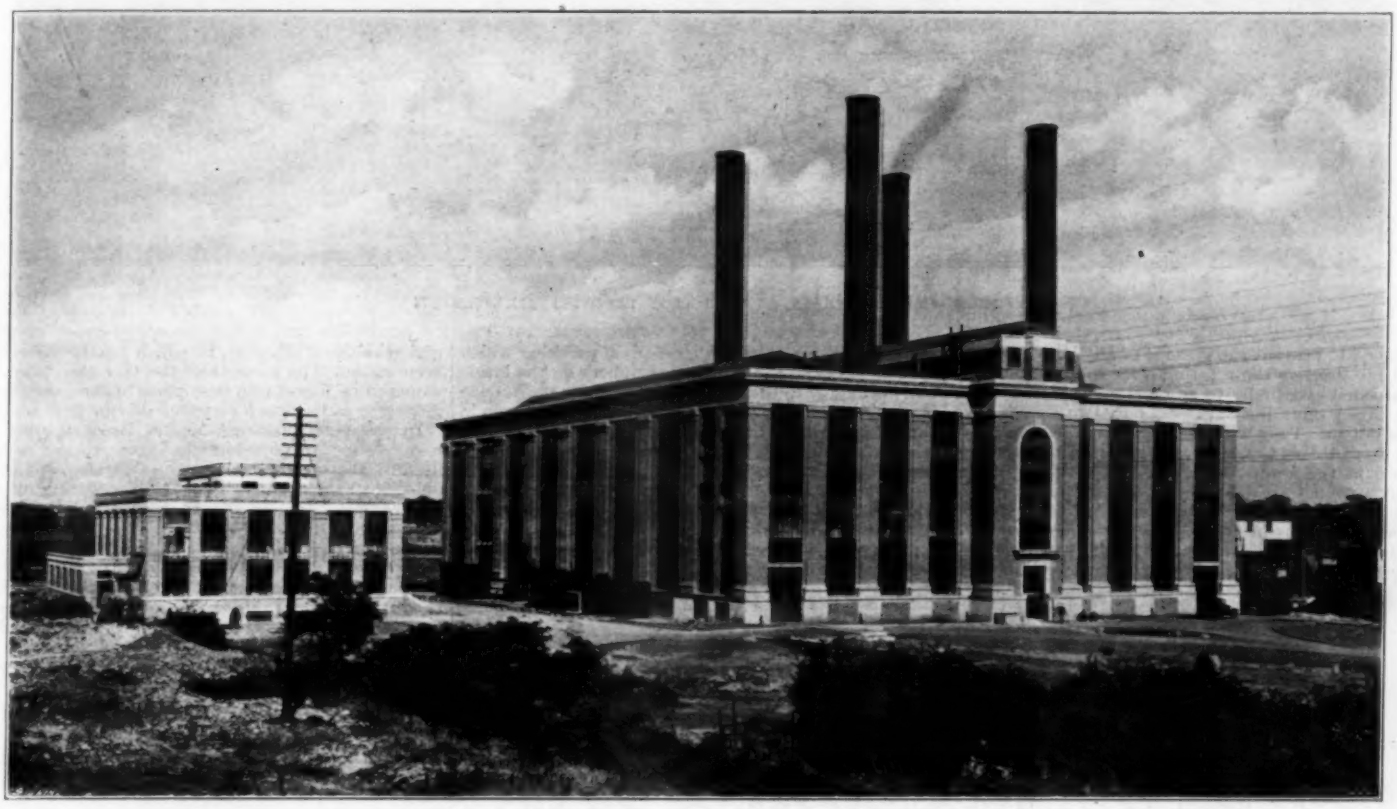


FIG. 3—GENERAL VIEW OF THE FERRYBRIDGE POWER STATION AND SWITCH-HOUSE

THE FERRYBRIDGE ELECTRIC GENERATING STATION

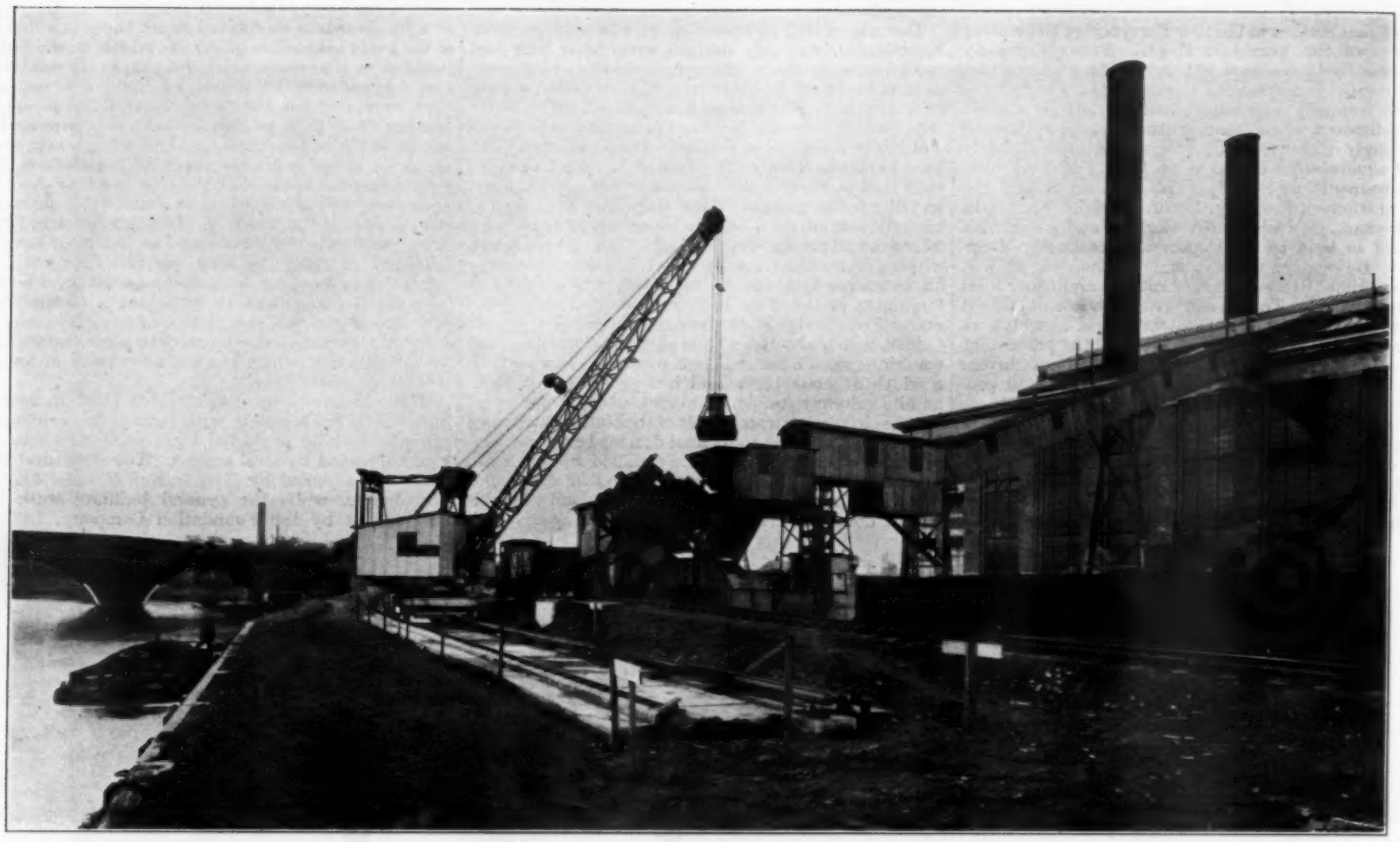


FIG. 4—VIEW OF WHARF SHOWING COAL RECEIVING ARRANGEMENTS

provided to prevent the passage of any large material likely to damage the rotating screens. The building is intended eventually to accommodate three screens and three pumps, but at present only two screens have been put in. They were supplied by F. W. Brackett and Co., Ltd., of Colchester, and their arrangement is shown in the accompanying drawing. Each of the screens, which are of the makers' "Disc" type, is 27ft. in diameter and each is designed to deal with 3,000,000 gallons of condensing water per hour as a minimum at the lowest water level, the immersion under those conditions being 9ft. The large diameter

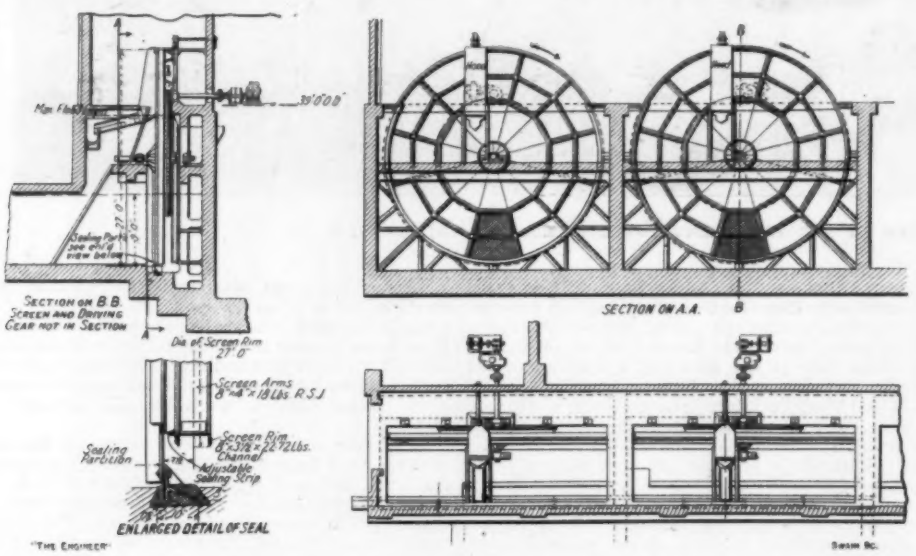

Min Flood
Sealing Parts see detail view below
SECTION ON B.B. SCREEN AND DRIVING GEAR NOT IN SECTION
Dia of Screen Rim 27'0"
Screen Arms 8"×4"×18Lbs R.S.J.
Screen Rim 8"×3½"×27·2Lbs. Channel
Sealing Partition
Adjustable Sealing Strip
ENLARGED DETAIL OF SEAL
SECTION ON A.A.
"THE ENGINEER"

FIG. 5—REVOLVING DISC CIRCULATING WATER STRAINERS

of screen was necessary to meet the 10ft. variation in the height of the water in the river which occurs at this point.

Although these screens conform generally with the firm's standard, they were modified in several details to meet the somewhat unusual conditions pertaining to the site and also the special requirements of the Power Company. They had, for instance, to be designed to withstand a hydrostatic pressure on one side of 20ft. of water and, hence, are of specially robust construction throughout. The perforations in the mesh plate are $\frac{1}{16}$ in. square, and the plates are very heavily galvanised.

Then, again, instead of the usual masonry construction to form the sealing partition round the periphery of the screen, a steel plate partition which approaches close to the screen periphery on the inside and fits closely to the walls of the sump on the outside is provided for each screen. Each screen has to run in this partition with a very fine clearance to prevent the passage of any rubbish floating on the water, it being essential, of course, that nothing should be able to pass through the screen that could not get through the meshes of the screen. The sealing arrangement is illustrated in the drawing. Generally speaking, screens of this type work in the open air, but in this case they are in the same building as the circulating water pumps, as we shall explain when we deal with the latter in our next issue.

The drive to the screen is taken on a heavy cast iron toothed wheel, built up in sections on the back of the screen frame, which is engaged by a cast steel pinion mounted on a shaft carried in heavy cast iron plummer blocks and rotated by means of a motor-driven gear. Each screen has its independent driving gear, which comprises, first of all, a three-speed motor, having speeds of 750, 960, and 1450 r.p.m. This motor is flexibly coupled to a totally-enclosed machine-cut worm gear. The slow-speed shaft of this worm gear is, in its turn, coupled to the high-speed shaft of a totally-enclosed, oil-immersed spur reduction gear, the slow speed shaft of which is directly coupled to the pinion shaft of the gear, to which reference has just been made. The motor and the two gear-boxes are mounted on a cast iron base-plate in the case of each screen, so as to form a complete driving gear set.

In this particular case Messrs. Brackett were not required to provide cleaning water pumps, as they usually do, since a high-pressure service was available, but provision was made for connecting up that service to the jet pipe of each screen. It is interesting to note that variable-speed "disc" screens were used in the company's Thornhill Power Station in the very early days of that type of water strainer, and that the strainers at Ferrybridge are the third pair that have been supplied by Messrs. Brackett to the same company.

On page 488 we give interior views of the engine and boiler-rooms of this interesting station, and we shall refer to them more particularly in our next issue.

(To be continued)

VIBRO CONCRETE PILING.

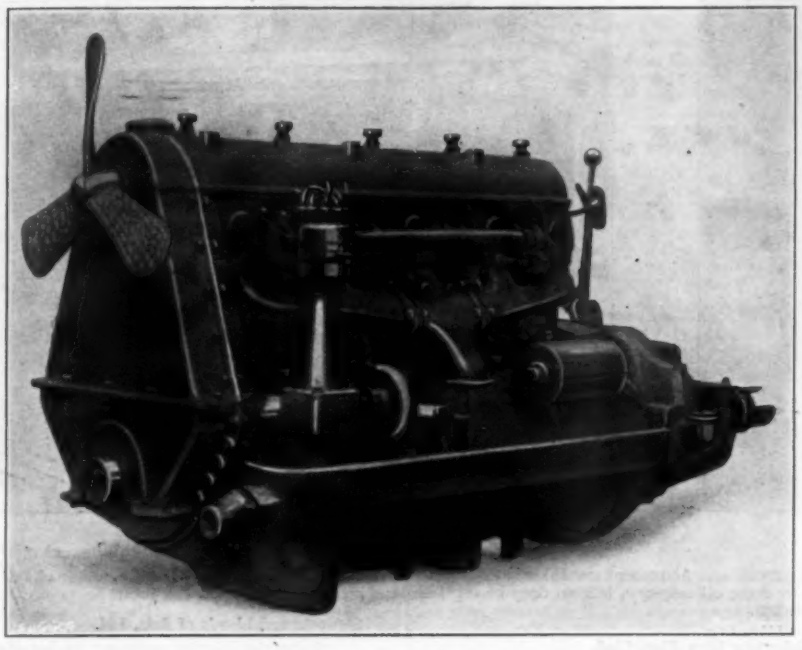
At a meeting of the Junior Institution of Engineers, held on October 21st, Mr. M. McCarthy described to the members the vibro system of concrete piling. This description of the system came at a very appropriate time, because the system is at present being used for consolidating the foundations of the new building to be erected near St. James' Park Station for the Underground Railways Group. This work is being carried out in a neighbourhood where there is a big concentration of engineers' offices, and has therefore attracted the attention of a great many persons who have an interest in such matters.

Mr. McCarthy explained that the first operation was to drive a tube having a special shoe down the required distance by means of a quick single-acting steam hammer operating upon a suitable cap. The next operation was to fill the tube with concrete. The third operation consisted of combined tamping of the concrete and withdrawal of the tube. The same apparatus that was used for driving was used, after necessary adjustment, for the third operation. The hammer was jerked upwards so as to lift the tube about 2in. The hammer then fell, and although the main force was taken by springs the tube was struck and dropped down 1½in., the net rise being therefore ½in. In the downward set of the tube the specially shaped end of the tube tamped the concrete well into the recess caused by the withdrawal of the tube. This operation was repeated eighty times a minute. An addition to the amount of concrete in the tube could be made at any time through a special opening without disturbing the driving gear at the top. Mr. McCarthy demonstrated the principles of the system by means of a working model, and completed his remarks with references to other forms of piling, including interlocking steel section piling.

The Physical Society and the Optical Society.—The eighteenth annual exhibition of electrical, optical and other physical apparatus is to be held by the Physical Society and the Optical Society on January 10th, 11th, and 12th, 1928, at the Imperial College of Science and Technology, South Kensington.

18 H.P. 8-CYLINDER MOTOR CAR ENGINE

BEVERLEY WORKS, BARNES, ENGINEERS



An 18 Horse-power Eight-cylinder Motor Car.

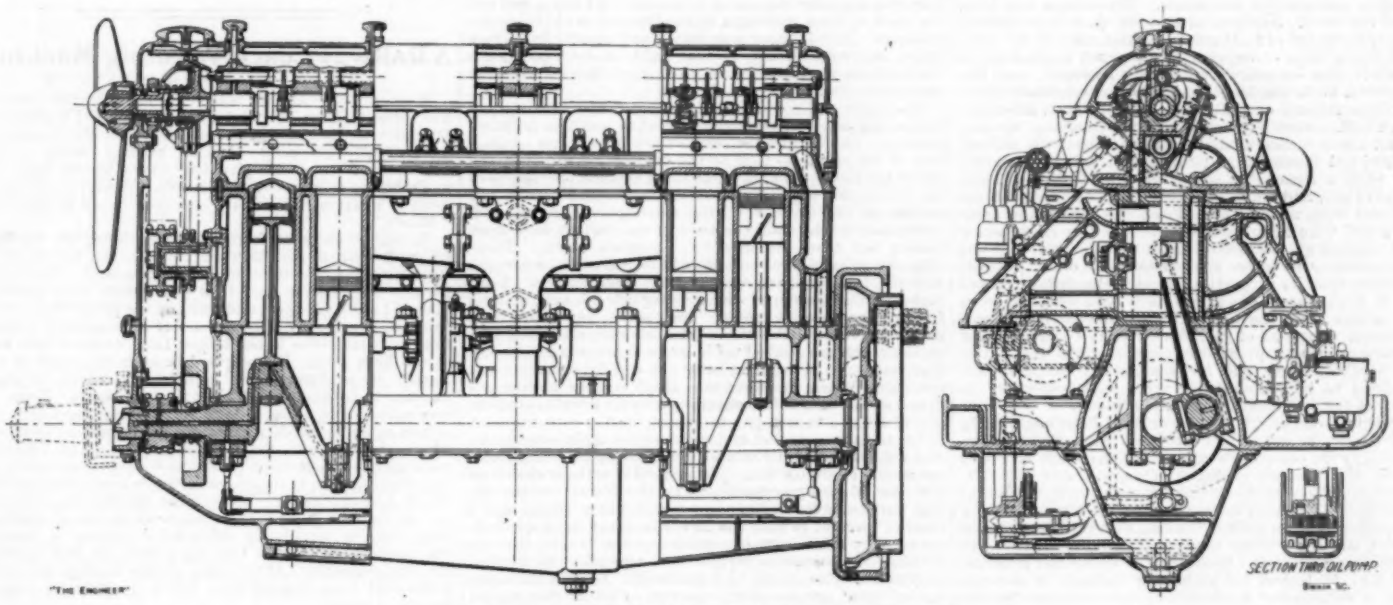
We received too late for inclusion in our series of articles on the recent Motor Car Show the drawings of the engines of the 18 horse-power Beverley-Barnes car, which is a moderate priced eight-cylinder British production. The drawing is, however, reproduced herewith together with a view of the engine as a whole. The cylinders of this eight cylinder-in-line engine are cast *en bloc*, and have a bore and stroke of 63·5 by 108 mm. respectively, giving a total capacity of 2736 c.c. and a Treasury rating of £20. Overhead valves are employed, and they are operated by rockers from an overhead cam shaft carried in five bearings on the detachable cylinder head. The cam shaft is driven by a silent chain from the forward end of the crank shaft, and a similar drive is provided for the dynamo and water pump, two separate excentrically mounted jockey sprockets serving to provide adjustment for these two drives. A torsional vibration damper, together with a three-bladed fan are mounted on the front end of the cam shaft, as will be observed from the drawing. The eight-throw crank shaft is of the 2–4–2 type, and is carried in five bearings in the aluminium crank case.

Delco-Remy battery and coil ignition is fitted, and it incorporates an automatic advance and retard mechanism as well as the ordinary hand control. The distribution is accessibly placed on the near side of the power unit, and driven through a 2–1 skew-gear reduction from the water pump shaft. The induction system is situated on the off-side, and it embodies a hot spot directly heated from the exhaust. The mixture is supplied by a single Stromberg carburetter, fed by Autovac from a 12-gallon petrol tank situated across the rear of the chassis.

Aluminium pistons and duralumin connecting-rods are used, and lubrication is afforded by means of a duplex gear-type pump submerged in the aluminium sump, the high-pressure side supplying oil under pressure to the main bearings, and thence through the drilled crank shaft to the big ends, while the low-pressure side serves to feed the cam shaft and overhead gear.

Unit construction is employed for the engine, clutch and gear-box. The drive is taken through a single dry plate clutch to a four-speed gear-box, provided with a right hand change speed lever, giving ratios of 18, 11·3, 7·75 and 4·7 to 1. The final drive is by open propeller shaft to an understrung spiral bevel rear axle of the full floating type. The steering is by worm and sector. Semi-elliptic springs, assisted by shock absorbers, are fitted both front and rear. The vehicle has internal expanding four-wheel brakes operated by the foot pedal, the hand brake operating on the rear wheels only. A 12-volt Smith lighting and starting set is included in the equipment.

The car is made at Beverley Works, Barnes.



ENGINE OF BEVERLEY-BARNES 8-CYLINDER MOTOR CAR

South African Engineering Notes.

Road Motor Services.

Between April 1st and June 30th of this year the South African Railways Administration introduced fourteen new road motor services, covering 429 miles, while two services with a mileage of 68 were withdrawn during the same period. One of these latter was rendered unnecessary on account of new railway construction, while the other, 29 miles in length, was withdrawn because the traffic was not sufficient to justify its continuance. At the end of June last the open mileage for all road services was 4755. Since that date a further 200 miles have been opened, while several other new routes have been sanctioned and will be opened as soon as vehicles are available. The growth of the road transport system of the railways has not increased so rapidly recently as was anticipated. This is due to the springing up of private road services which are competing with those of the Railway Administration. In the large centres of the Union, where there is heavy suburban passenger traffic, motor omnibus competition is hitting the trains hard. Instead of the fight for passengers being between the trains and trams, as used to be the case, both have now to face the competition of the motor omnibus.

Durban Grain Elevator.

The chequered career of the construction period of the grain elevator at Durban was brought to a close a few weeks ago, when official trials were carried out in the presence of Mr. R. Wallace, chief civil engineer, and the local railway and harbour officials. Fifty-three 40-ton trucks of maize comprised the test load, and were disposed of at the rate of one every six minutes. The total capacity of the plant is 1,500,000 bushels, or 42,000 tons, of which the working house holds 15,000 and the storage annexe 27,000 tons, while the full working speed is 1000 tons per hour. The nine floors of the superstructure rise to a height of 185ft., or 28ft. above the dome of the Durban Town Hall. The first large shipment from the elevator was taken by the Cambrian Maid, the first vessel to arrive at Union ports under the flag of the new London and Continental line formed to oppose the existing shipping combine. This vessel took just over 9000 tons.

More Rolling Stock for S.A.R.

Tenders have just been invited for the supply of a further forty big railway locomotives for the South African Railways. Thirty-six of these engines are to be used on branch lines, and the remaining four are to be shunting engines. Twenty-three of the branch line locomotives are to be stationed at Durban, ten at Bloemfontein, and three at Uitenhage. Two shunting engines are also for Durban, and the other two are for Pretoria. Tenders must be in before November 24th. The shunting engines are to be constructed to the tenderer's design. It is the intention of the Administration to experiment with a view to discovering the best type of locomotive for shunting purposes. In addition to the forty locomotives, tenders are being invited for fifty second-class main line saloons. These are to be constructed to the design usual for such saloons now in use on the railways, with several improvements of a minor nature. The saloons are wanted to relieve expected congestion on the main line next season. The two contracts will run into several hundreds of thousands of pounds.

Search for Oil in S.A.

At the present time serious attempts are being made to discover oil in South Africa. The efforts of three companies, which are making them, deserve special notice, as the concerns are financially strong, have the best technical advisers, from the geological and mining engineering points, who can possibly be obtained, and are working at three places widely separated. Those places were selected after long periods of prospecting, testing with drills, and careful deliberation. One of these companies, the Petroleum Corporation of South-West Africa, is conducting operations in South-West Africa in the Keetmanshoop district. Dr. L. Reinecke, one of the most eminent of South African geologists, who has had great experience, has recently paid a visit to the company's borehole, which had then reached a depth of 1600ft. After describing the various strata passed through by the drill, Dr. Reinecke states that he estimates the thickness of the Fish River sandstones, in which boring is now proceeding, at 2000ft., though other observers have calculated a lesser thickness. Below these sandstones about 750ft. of shales and sandstones of the Schwarzkalk formation and 100ft of Schwarzkalk limestones and shales are looked for. They should be comparatively easy to drill. If oil is present in this locality it will be encountered above the base of the Schwarzkalk. Dr. Reinecke observes that references have been made to opinions he is supposed to have expressed, and he therefore wishes to make the following statement:—"Drilling for oil in a virgin field, such as this one, is in all cases a gamble. In this instance we are dealing with formations that are geologically very old. The changes that take place in such formations

LONDON UNDERGROUND RAILWAYS—COACH WASHING MACHINE

through the ages tend to dissipate accumulations of oil and make the pools that do remain hard to find. Formations of great age can, however, contain oil, and such formations have yielded vast productions in Illinois and other fields of the United States. Oil occurs in several seepages in the Fish River Valley, and I believe that the oil came into its present position from below. I have advised drilling because several of the seepages occur in connection with structures that may be considered suitable for the formation of oil reservoirs. Tests made on certain shales in the underlying formations indicate also that the formations that are supposed to have produced the oil seepages have undergone comparatively slight change. We may expect therefore that certain of the original oil reservoirs still remain."

A second company, the Devon Petroleum Syndicate, is testing a property in the Heidelberg district of the Transvaal, where it owns fourteen farms surrounding Gruisfontein and covering an area of about 27 square miles. It includes the farm Gruisfontein on which the first discovery of natural gas was made. The escape has been known for years. Analyses of this gas show it to contain a large percentage of methane, combined with 10 per cent. hydrogen, a trace of oxygen, and a small percentage of nitrogen. The company's consulting geologist, and Dr. R. Marloth both considered that the gas originates from rock oil (petroleum or similar deposit). Mr. H. J. Ibbotson, M.Inst. C.E., consulting engineer to the company, advised that all the evidence available fully justified the sinking of additional boreholes in Gruisfontein and surrounding areas with a reasonable expectation of finding a large volume of gas, and a distinct possibility of finding the gas associated with mineral oil. From the outset the company's activities have been directed to the exploitation of the natural gas occurrence upon Gruisfontein, and the work necessary to prove the existence of oil in payable quantities upon its properties. During the drilling operations at Gruisfontein gas shows have been obtained from time to time, and the possibility of encountering larger volumes or reservoirs of gas, the directors consider, must naturally only be a question of time, and the drill. The potentialities of the gas for commercial purposes are considered to be undoubtedly very great, especially in respect of the manufacture of carbon black.

The third company is the Inyaminga Petroleum, Ltd., which has its property in Portuguese East Africa. The reasons why the company's experts, which include Mr. F. P. Mennell and another geologist of repute, and also Mr. J. van Tijn, who was at one time oil geologist to the Royal Dutch Shell Company, expect to find oil there is that a geosyncline is known to exist running with the Mozambique Channel, and the western shore of that sea offers the only field in this part of the Continent in which the presence of oil may be looked for with some measure of success. As far as Madagascar is concerned, the conditions for the formation as well as for the accumulation of oil have been favourable, but that country has been in later periods denuded to such an extent that those accumulations have been exposed and destroyed. The sun has to a great extent volatilised the lighter constituents of the oil and left the residues of solid bitumen, which are prevalent in that island. On the opposite side of the Mozambique Channel (Portuguese East Africa), however, geological investigations extending over more than five years, and made by Mr. F. P. Mennell—and subsequently checked by Mr. J. van Tijn and Mr. W. C. van Soelen—show that whereas the conditions for the formation and accumulation of the oil are as good there as they were in Madagascar, the third condition, that of oil storage, which is wanting in Madagascar, yet prevails on the East African coast. An anticline or dome of large dimensions has been discovered, and it is covered with impervious capping, so that the oil-bearing strata are undisturbed. It is in this territory, which combines all features favourable for the finding of oil that the Inyaminga Petroleum, Ltd., is conducting boring operations. The borehole has been sunk to 200ft. A 17in. diameter conductor casing is being inserted to 148ft. where the change over to a 15in diameter bit is being made. Progress is at the rate of 3ft. per hour while drilling, and van Tijn expects that a speed of 150ft. per week will be maintained by the plant. Nothing of a particularly interesting nature is expected until after the 2000ft. level has been reached.

Should one or other of these three companies be successful in finding oil it will, of course, give a great impetus to further prospecting. At present several other localities are known to share oil seepages, but no deep boring has been undertaken.

Cape Suburban Line Electrified.

The electrification of the suburban lines of the Cape Peninsula is now approaching completion, and the change over to the new system will become general early next year. The short section between Cape Town and the fashionable seaside resort, Sea Point, will, it is expected, be run electrically before the end of this month. The first train was run over that section on September 26th. The distance is about 5 miles, but the train was only run as far as Milton-road, a stretch of 4 miles. There were no stops on the run from Cape Town, but speed was reduced at stations, and the time taken was 6 minutes 26 seconds. On the return trip the time taken was 7¼ minutes, which included three stops, one being for 1½ minutes. The notable features were the rapid acceleration and retardation with an entire absence of vibration and jolting, and not the least of the advantages is the elimination of the smoke nuisance. The lighting was tested and proved in perfect order, and with twenty 25-watt lights in each coach the illumination is very superior to that on the carriages at present in use.

The train run comprised six coaches and consisted of two motor coaches, two driving trailers and two ordinary trailers. The two motor coaches are placed one at each end of the train, so that at the completion of a run the driver has merely to walk to the other end and operate there for the return trip. The two driving trailers are in the middle of the train, with the driving ends facing each other, so that the train can be split into two at very short notice, and there are then two complete units. These separate units of three coaches will be run at slack periods, and the full six-coach train during rush periods. Each motor coach is equipped with a motor on each axle, making four motors on each coach. They are in pairs, and both pairs are connected in series. When starting all four motors on the coach are started up in series through a resistance. The resistance is automatically cut out by operating the controls. When the resistance is all out the motors are in full series, then before changing into the parallel position the resistance is engaged in circuit by the advancement of the master controller and resistance is again automatically cut out until the motors are running in full parallel across the 1500-volt line. The control is entirely electrical and not electro-pneumatic, as in the Natal equipment. One particular feature of the controller is a "dead man's handle," which, in case the driver becomes incapacitated, operates by the release of pressure on the handle, thereby cutting off the motor current and applying the brakes, so that the train comes to a standstill. Besides the main motor there are auxiliary motors. One is the motor generator, which supplies current to the master controller, and provides light throughout the train. The voltage for this supply is 110. The other auxiliary is the motor exhauster, which provides the vacuum for the main train pipe, for applying the brakes, and also for lifting the pantographs which collect the current from the overhead wires and pass it to the motors. When the brakes are applied there is an electric valve which closes between the exhauster and the main train pipe during the time the brakes are applied.

The weight of the motor coach without passengers is 60 tons, and it is estimated that a fully loaded motor coach will weigh an additional 6 tons, giving approximately 66 tons for the coach and passengers. Each ordinary coach carries about 80–85 passengers, the coaches containing the motors somewhat fewer. As there are four axles to a coach, the weight on each axle is about 16½ tons when fully loaded. In the event of a pair of motors failing on a motor coach, a switch is provided for cutting out the faulty pair, and the remaining pair can continue working. In the event of a motor generator failing, the current can be supplied, providing there are two motor coaches on the train, from the remaining motor generator set. The trains can be run at speeds up to 50 miles per hour.

The equipment for the whole of the suburban system, when the electrification is completed throughout the Peninsula, will consist of 83 motor coaches, 37 driving trailers, and 96 ordinary trailers, all new stock. The horse-power rating of the main motors on one-hour test is 185. The six-coach trains will weigh about 263 tons and an eight-coach train 359 tons.

Stewarts and Lloyds of S.A., Ltd.

Quite the biggest company registration during the month of September was that of Stewarts and Lloyds of South Africa, Ltd., which was registered at Protoria as a public company with a capital of £755,000. It is understood that in addition to taking over the present merchant business of Stewarts and Lloyds (S.A.), Ltd., the new company will manufacture tubes at Vereeniging. The foundations of the new works are now in hand, and it is expected that the new undertaking will mean another substantial addition to the growing list of prosperous industries established at Vereeniging in proximity to the Union Steel Corporation's works. It is an open secret that but for the attitude of the present Government two other large British manufacturers, viz., Messrs. Baldwins and Lysaghts, would also have started branch industries in this country.

A Railway Coach Washing Machine.

A machine which, we believe, is novel in this country has recently been installed by the London Underground Company at its Ealing Common depôt for the purpose of mechanically cleaning electric railway stock. This machine, of which we give two views above, has been made by the railway company's own staff and is a development of a rather similar device already in use on the Paris "Métro."

As will be gathered from the illustrations, the coach to be dealt with is run between two screens, inside which there are rows of vertical rotating "brushes." The coach, by the way, travels under its own power at a speed of about 1½ miles per hour, and picks up the propelling current from an overhead rail by means of a temporary connection, so that there is no danger from exposed live rails at the floor level. The vertical brushes are made of soft leather strips fixed on to spindles by means of hooks in order to facilitate renewal as they are worn. There are four spindles on either side of the machine, and they are driven at a speed of 50 revolutions per minute by overhead bevel gearing from longitudinal shafts. The adjacent pairs of brushes revolve in opposite directions, and footstep bearings are, of course, provided to carry their weight. There are two electric motors for driving the shafting, one on either side, so that in the event of one set failing a coach can be completely cleaned by running it through the machine twice and turning it end for end between the two passages. Above each of the brushes there is a perforated hoop-shaped pipe which provides a copious supply of water.

It will be readily understood that as the spindles rotate, the wet leather washers will stand out, under the action of centrifugal force, and, striking the sides of the coach, will clean it effectively. As an added precaution, however, a set of water jets is projected against the sides of the coach as it leaves the machine to wash down any loose dirt.

It is obvious that such a machine must effect a very considerable saving in labour, as compared with the usual system of hand washing, and incidentally the coaches are not detained in the shed so long. We understand that, as a matter of fact, the rolling stock can be cleaned more quickly in the machine than it can be re-marshalled in the yard outside. The cars are passed through the machine every four to six days for the purpose of a wash-down and for window cleaning. They are also periodically scoured to remove all dirt, which may gradually accumulate on the paint work, and are then again passed through the washing machine.

Institution of Naval Architects: Scholarships.—The following scholarships have been awarded by the Council of the Institution of Naval Architects:—"Vickers" Scholarship in Naval Architecture (1927), £150 per annum, to Mr. Lawrence Johnston, of John Brown and Co., Ltd., Clydebank; "Denny" Scholarship in Naval Architecture (1927), £75 per annum, to Mr. P. F. Foss, of Dousi School, Woolhampton, Berks.; "Denny" Scholarship in Marine Engineering (1927), £75 per annum, to Mr. L. G. Kirton, of The Crypt School, Gloucester.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Unchanged Conditions.

The trading situation in the heavy industries of the Midlands and Staffordshire is much as last week, and the iron and steel market has received no new impulse. Buying is for current needs only, and those needs would appear to be small indeed. It says much for local industrialists that they, under existing unsatisfactory conditions, maintain an optimistic outlook. They are inclined to pin their faith now to the New Year, being of opinion that it is too late to expect any great reinvigoration of trade this quarter. There is not sufficient confidence in the forward position to induce users of iron and steel to commit themselves farther than they can see. The rally of pig iron would be more widely welcomed if consumers could persuade themselves it portends a return to market stability. Their own order books scarcely warrant such an assumption, however. Some of the local trades report improved business, and that will necessitate increased purchases of material in the near future. The engineering and heavy foundries are busier, as are most of the jobbing foundries. The light castings trade is doing fairly well, though the output is not what it was, and the pipe foundries are active. It follows therefore that purchases of iron should increase. In the steel department the shipbuilding revival will result in better orders for plates and the large orders booked by motor engineers at the recent Motor Show ought to result in additional business for the steel makers.

Raw Iron.

On 'Change in Birmingham this week pig iron has furnished the chief, if not the only, source of interest. The determination with which makers have adhered to the advanced prices has proved somewhat of a surprise to consumers, and a certain number of the latter, who have been buying only in very small quantities for a long time, after carefully weighing the situation, are now negotiating contracts to carry them into the New Year. There are buyers, however, almost as apathetic as ever, and they continue their policy of hand-to-mouth transactions. Up to the present the forward buying movement has not been generally accepted. There is no sign of excitement in the market. The orders negotiated have not been of sufficient magnitude to bring about any tension, and that the upward movement, once started, should have made so little headway argues a shortage of work at the foundries. Orders have been fairly steady so far as the light foundries are concerned, but there has been little, if any, improvement in the aggregate turnover. Midland blast-furnacemen state that their stocks are now exhausted, and should there be any change in the relations of supply and demand, prices are likely to go higher. This week Derbyshire No. 3 foundry was generally quoted £3 6s., but some sellers held out for £3 7s. Northamptonshire, which has not the support of the Lancashire market, or the strong backing of the pipe foundries in the same degree as Derbyshire, has firmed up somewhat on the strength of the improvement in Derbyshire, £3 1s. being now quoted by nearly all sellers. North Staffordshire makers are asking £3 6s. for their output. But only foundry iron has been affected by the turn of the scale up to now, and, indeed, forge pig barely maintains the old position. Derbyshire makes can be bought at rather less than 60s., and for Northamptonshire 54s. is the basis. Ironmasters are now looking and hoping for an improvement in consumptive requirements, and on 'Change in Birmingham to-day—Thursday—the chances of the development of demand in the near future were considered more promising.

Steel.

Nothing has occurred to put any animation into the steel trade of this district. The business being done does not approach to a fair average. Orders for structural material are slow, but big contracts are believed to be pending. Consumers are ordering in small quantities for prompt delivery. The shipbuilding revival is reported to have brought many orders for ship plates, prices of which are firm at £8 7s. 6d. Some congestion on the North-Eastern Railway is reported, one Midland firm of constructional engineers having to wait a fortnight for a consignment of steel, but supplies from Midland steel works can be obtained promptly. The steel roll makers are busy supplying heavy machinery to large steel plants, and the improvement in the shipbuilding areas has also brought some good contracts for heavy forgings, firms making the latter being busier than for some years. It is interesting to note that a careful perusal of last month's trade returns shows some recovery in steel sections, and that the export of hoops and strips, though still disappointing, was an advance on the August volume. Thin plates and sheets took an upward turn again, as did also tinned and terne plates and sheets. A decline in cast tubes and fittings was more than compensated by a large turnover in wrought manufactures. Better trade in steel rails to the extent of 12,000 tons more than offset a small reduction in other descriptions of railway material. Continental steel mills are making a bold bid for the English trade. Advices from the Continent this week offer steel joists—to the British standard of 28–32 tensile—at £4 12s. 6d., and steel bars at £4 14s., both f.o.b. Antwerp. No. 3 iron bars are also quoted at £4 14s.

Staffordshire Bar Iron.

There is no marked alteration in the Staffordshire finished iron trade, though in some quarters an accession of demand is reported. Makers of marked bars are alone making any real output, however, and even in this department inquiries are for small quantities, so small, in fact, that at the ruling price of £13 the business can scarcely be remunerative. Crown bar business is small and spasmodic, Lancashire houses, it is stated, taking all the plums. There is a slightly better call for chain, cable and anchor iron, but nut and bolt and fencing bars find few buyers, despite the fact that the nut and bolt works are better employed than they were a month ago. Practically all the material used is now procured from the Continent at pounds below local makers' prices. Wrought iron gas tube strip sells steadily at £11 12s. 6d., the tube works being moderately well engaged.

Galvanised Sheets.

The demand for galvanised sheets continues to advance, and large tonnages are going abroad. Last month manufacturers had an excellent month, adding nearly 10,000 tons to the August total of 65,130 tons. Values of 24 gauge corrugateds still range from £13 15s. to £14, a figure midway between the two representing the price generally accepted by local mills.

Scrap.

The scrap market remains poor, buyers and sellers being unable to agree upon values. Most of the steel scrap being sent to South Wales is sold at £3 per ton delivered, though buyers press for acceptance of orders at £2 17s. 6d. Steel turnings command £2 10s.

Fuel.

Midland blast-furnacemen are fortunate at the moment in that they are able to obtain hard coke at rather lower prices. Current quotations of 12s. to 13s. at ovens compare very favourably with the price which smelters have had to pay since the war. Despite the fact that ovenmen have reduced output, stocks are stated to be accumulating, and that has resulted in some shading of prices. Sales of steam coals and other works fuel do not throw a very cheering light on the trade situation. Demand remains unresponsive, and prices weak.

New Midland Highway.

It is anticipated that the new Midland highway connecting Birmingham and Wolverhampton, which was to have been opened by H.R.H. the Prince of Wales on Wednesday next, will do much towards reviving the industrial use of an area which has been derelict for many years. The road, which is an entirely new one, is approximately 10 miles in length, and runs through Oldbury, Hales Owen, Rowley Regis, Dudley Tipton, Coseley, to the Wolverhampton boundary. The first portion of the route is through undeveloped agricultural land, and the remainder is through what is known as the "Black Country," a good deal of which, upon the site of the road, consists of areas formerly occupied by various industrial undertakings, such as mining, quarrying, ironworks, &c., most of which have been worked out for many years, rendering the area derelict. The width of the roadway is 100ft., with a 40ft. carriageway, and it has been designed to take both heavy and fast traffic. The bridges which have been built over the canals have a width between parapets of 60ft., and those constructed to carry the railway over the road have spans of 60ft. Seven large bridges have been built, consisting of three over canals and four under railways. In addition, three smaller bridges required for various purposes have been constructed. Foundation difficulties have been considerable, and have entailed the making of high embankments and deep excavations in the sides of great mounds of cinder, the filling up of deep clay quarries, &c. The total cost of the work will be approximately £600,000.

Motor Engineering Prospects.

The motor engineering industry in Coventry, Birmingham and Wolverhampton is bound to make marked progress in the coming year, and manufacturers this week speak very hopefully of the trade prospects. Some of them go so far as to predict a more prosperous year than has ever been known before. It is computed that as a result of the orders booked at the Motor Show at Olympia the industry as a whole during 1928 will be able to absorb some 86,000 of the unemployed. The reports of the Coventry motor firms are encouraging, the demand for the improved saloon bodies being emphasised. As an earnest of these satisfactory reports, it can be added that the factories are already becoming more active. Further men will be absorbed into labour next week, and still more as the weeks go on. Wolverhampton manufacturers are well satisfied with the outlook, and state that there is every indication of good business developing. In South Staffordshire generally the success of the Motor Show is looked upon to a large extent as a fairly reliable trade barometer, and from this point of view there is no need for pessimism. This district has every prospect of attracting its fair share of business, and this should enable the other industries of South Staffordshire to keep going until more stable conditions are at hand. One has to take the optimistic views expressed at the Motor Show with a certain measure of reserve, but manufacturers now returned have immense confidence in the future prospects of the motor engineering industry, and many are much elated.

Rolling Stock.

Midland rolling stock establishments remain fairly well placed for work, and employment is assured at least to the end of the year. The contracts in hand are chiefly on export account, though some works have a number of orders for home railways in course of execution. New business continues to be booked, but not as rapidly as makers would like. I learn that the Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, has secured a contract from the Cheshire Lines Committee for three four-wheeled covered carriage trucks, two bogie milk trucks, and three horse boxes. Another railway contract which has recently come into the Midlands is one to the Sentinel Waggon Works, Ltd., of Shrewsbury and London, for a 200 H.P. double-engined, double-geared Sentinel 25-ton locomotive, for service on the Palestine Railways.

Unemployment.

A further decrease last week of 3069 brings the number of unemployed in the Midlands down to 122,156. Unfortunately, slight increases were recorded in the following Black Country towns:—Cradley Heath, Dudley, Smethwick, Wednesbury, and West Bromwich. In Birmingham the number declined from 25,611 to 24,974, a reduction of 637, while in Coventry the number of workless was 114 fewer than a week ago. Now that the Motor Show is over, production in the Coventry engineering industry will go ahead again, and it is anticipated that next week's unemployment returns will show a marked improvement. What is now needed to bring down the unemployed figures is a re-animation of the heavy industries. Few hands are being re-absorbed into the basic trades of South Staffordshire; on the contrary, most weeks witness an increased number of iron and steel workers signing at the labour exchanges.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Self-Help in Basic Industries.

PRESENT-DAY difficulties in the iron and steel and engineering industries were discussed from different aspects, but with the same object in view, by Sir Francis Joseph, President of the North Staffordshire Chamber of Commerce, and Mr. P. W. Lee, Master Cutler of Sheffield, at a meeting of the Manchester Publicity Club. Discussing the question, "Can advertising save our basic Industries?" Sir Francis referred to the unparalleled success of the motor car industry in this country, which he attributed largely to the cumulative effect of advertising. In this way the industry had overcome trade depression, and now employed more men than the railways. The condition of the basic industries in this country was, he said, a matter of vital concern, and things were serious. The coal, iron, steel, engineering and shipbuilding industries were all working short-time, and many of the firms in each of these industries were living on their reserves. It was time to call in a specialist, and the publicity agent was the man whose opinion should be sought. The return on the capital invested in the basic industries was so low that fresh money could only be got with great difficulty, even for sound propositions. Whilst, with the exception of agriculture, coal was the most basic of our industries, it was definitely linked up with the iron and steel trades, and could only be prosperous if the latter, which to-day were in a parlous condition, were busy.

Short-time Demoralising.

Mr. Lee dealt with the iron and steel industries from the point of view of the imports of foreign materials, the effects of which he expressed in terms of pounds, shillings and pence. The value of the imports of iron and steel during the first half of this year he gave as £20,000,000. Taking 80 per cent. as representing wages, that, he said, meant a loss of £16,000,000, or, at £3 a week, work for 210,000 men for the six months. Full time meant lower prices but, at the present moment, the British iron and steel industries were only working at two-thirds of their capacity. Short-time, far from being a solution of industrial difficulties, was characterised by the speaker as being demoralising to the workers, depressing to the management, and adding to the cost of production. Was it not possible, he asked, to get every business in this country to ask for British iron and steel. A common mark for goods of British origin could easily be conceived and applied. A steady increase in the productivity of the iron and steel and shipbuilding industries might well result in decreased prices, as had been so well proved in the motor industry. The sales organisations left a great deal to be desired, personal jealousies and suspicion being real stumbling blocks.

Non-ferrous Metals.

The non-ferrous metal market since my last report has witnessed a recovery in both tin and copper, and renewed weakness in lead and spelter. So far the suggested price-fixing arrangement in respect of tin has had no pronounced effect on the metal, although naturally it is probable that, in combination with several other factors, it has had a steadying influence. What is certain, however, is that there has been no anxiety among buyers to secure supplies at to-day's low values relative to the £300 which the promoters of the price-fixing project are said to have in mind. The strengthening influences on this section of the market during the past week have been a better demand for the metal from United States interests and the fact that, in anticipation of a substantial reduction in visible supplies at the month end, there have been fewer offers from sellers to "bear" the market. Copper has continued the steady recovery that has been in progress for a month or more, and prices at the moment of writing are higher than at any time since the beginning of August, with current values roughly £1 a ton better than a week ago. A reduction in American refinery stocks and a slight improvement in buying by domestic consumers have been features in this section. There has been little or no expansion in the demand for lead, and a further loss of ground, the present price of £21 10s. for English lead comparing with £30 in March last. Notwithstanding the fact that there have been no heavy offers of spelter during the week this metal is much weaker on balance, and the demand for industrial consumption remains extremely slow.

Iron.

There is evidence that the slowing down in the demand for pig iron on this market is less a question of a temporary lull than an indication that the majority of Lancashire users have bought as much as they consider necessary to meet their needs for the next few months. Occasional parcels for fair quantities are being bought, but these transactions are now spasmodic where before they were more or less constant. Staffordshire and Derbyshire makers who, by the way, are enjoying a considerable price advantage compared with both Middlesbrough and Scottish producers of pig iron, have benefited principally from the buying movement, and most of them express themselves as well satisfied with the tonnages booked in the aggregate. Some of them are virtually bare of stocks,

and are assured of an active run until well into January. In one case, I learn that a Derbyshire furnace that has been inactive for nearly three months, was put into blast last week-end. Quotations are steady all round, with Staffordshire at 73s. 9d., Derbyshire at 73s. 6d. to 74s., Middlesbrough at 80s. 8d., Scottish at 89s. 6d. to 90s., and hematite at about 86s. 6d., including, in each instance, delivery into the Manchester area or the equivalent. With regard to bar iron the position remains disappointing, the demand generally being poor and principally for small quantities. Lancashire Crown bars are quoted at £10 per ton and second quality bars at £9 10s.

Steel.

The position of steel makers' order books is, on the whole, extremely unsatisfactory, although here and there in the case of firms which for one reason or other are more favourably placed, the situation is less depressing. The demand for steel from general engineering firms in Lancashire shows no improvement. A fair business, however, continues to be done with constructional engineers and with locomotive builders, though in the latter case conditions are patchy, certain firms being in varying degrees of activity, while others are quiet. Prices are much the same as before, steel bars being offered at from £7 15s. to £8 10s. per ton, boiler-plates at £10 15s., joists and sections at £7 12s. 6d., and tank plates at £8 7s. 6d. There has been a moderate movement in galvanised sheets recently for the home market, but export outlets are showing little buying interest, and quotations are weak at from £13 10s. to £13 15s. per ton f.o.b. for the usual Bombay or Calcutta specifications. Latterly, there has been slightly more inquiry from India, but it has not been reflected in an improvement in actual business. In spite of the absence of any important buying of continental steel makers who are offering here are attempting to infuse a little more steadiness into a market which for some time has been gradually falling, and this week a somewhat higher range of prices has been quoted. For delivery to Lancashire users' works, for cash against shipping documents, continental steel bars are being offered at £5 14s. 6d. per ton, with angles at about the same figure, billets at £4 18s. 6d., sheet bars at £5 2s. 6d., ordinary plates at £7 2s. 6d., Siemens' plates at £7 10s., joists and sections at £5 12s. 6d., and wire rods at £6 7s. 6d.

Barrow-in Furness.

Hematite.

The improved condition of the hematite pig iron market is maintained. It cannot be said that the improvement is very marked, yet there is a better tone generally and customers are giving signs of being more inclined to place orders. The tonnage of deliveries has increased, and stocks are coming down at some of the works, where they had been accumulating up to a month or so ago. There has been an improvement in the shipment of pig iron to the Continent, but the tonnage going in that direction is not heavy as yet. America is showing a tendency to deal a little more extensively, and there is a chance of better business across the Atlantic. Business in special qualities of pig iron is moderate and may improve, but business in ore remains about the same. If pig iron stocks had gone on increasing there might have been some damping down and a reduction in the demand for local and foreign ore. This restriction has not come to pass, hence the mines are assured of a moderate demand for some time. The steel trade, as far as Barrow is concerned, is fairly well employed, and this condition will continue to obtain for some months. Fresh orders in the meantime may be secured. There are a few in the market, which may come the way of this district. As regards the hoop and small section departments business continues to be good.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Conditions.

It is the heavy steel departments that continue to show the greatest depression, and the demand for ordinary classes of steels appears to be on a decline. The production of open-hearth steel is probably lower now than at any time this year. Since the working off of the arrears accumulated during the coal stoppage, trade has been slack. Only a comparatively small number of furnaces were re-commissioned after the half-yearly stock-taking in July, but even this number has proved too much for the demand, and from time to time a furnace has had to be shut down in order to ease the position. This depression is also reflected in the heavy allied departments. The mills are not only running short of their capacity, but the financial burden imposed upon them in consequence is making it impossible for them to carry anything substantial in the way of stock. Everybody seems to be working on a hand-to-mouth policy. In special quality steels conditions are not quite so depressing. The effect of foreign competition is less severely felt, and the material generally commands a much freer market. A number of specialising firms report that they are getting busier, though here and there are cases where prices have had to be shaded in order to maintain the general forward movement.

United Steel Companies.

An admirable survey of the position was given by Mr. A. O. Peech, chairman of the United Steel Companies, Ltd., at the annual meeting in Sheffield this week. The Ickles works of the company are chiefly concerned with the production of high quality steels, and Mr. Peech stated that their efforts to expand business in these departments were having good results. Regarding this trade, conditions broadly had not been unsatisfactory. At the Templeborough works, owing to foreign competition, orders had fallen off during the last few months, and the proportion of output capacity employed was lower. Mr. Peech had some pointed comments to make with regard to foreign competition. The volume of trade being done in steel in this country by continental suppliers is greater than anything previously experienced, and, referring to this fact, Mr. Peech stated: "The Continent has, in fact, obtained a footing in the supplying of the steel and iron needs of British industry which places it in the position of a very formidable competitor. During the past year this competition has increased seriously, and the indications are that the pressure of it will continue to increase, not only in the heavy steel industry itself, but also in several of those trades in this country which use imported raw steel for the manufacture of their finished products. It is a comparatively new idea in the steel trade of this country to operate plant on mass production lines, but even with the short experience which we have had of this type of production, the enormous advantage obtainable by operating plants at full load has quickly been recognised. It results in the spreading of overhead charges, which are more or less fixed as to quantity, over a greatly increased production, and the consequent decrease in cost becomes cumulatively greater. The result of the policy of the continental nations has been that, with a protected home market they have been able to sell their surplus production in this country at prices fixed without reference to the economic cost. I maintain without hesitation that this type of competition is something beyond the ordinary meaning of the term, and is a form of competition which cannot be met by us unless we are prepared to adopt the governing policy which lies behind the basis of this competition."

Question of Safeguarding.

The remarks by Mr. Peech on the question of safeguarding the steel industry are significant. He said: "The application of the steel trade of this country for the benefit of the Safeguarding of Industries Act has been refused by the Government, notwithstanding a complete and detailed exposition of the difficulties under which we labour to-day, and which are beyond the control of the industry; but, in refusing it, the Government has stated that the reason behind its refusal is a fear as to the extent to which other trades would be prejudiced by the granting of safeguarding duties to our industry. I am far from anxious to introduce anything in the nature of party politics. The subject is one which, in my view, is of greater importance, but I do think it necessary that we, who year by year are in constant touch with the actual operation of these heavy industries, should put our position clearly, apart altogether from any question of politics."

Railways and Motors.

One of the disappointing features about the local steel trade this year has been the failure of the railway companies to adhere to the programme which was announced early in the year. Only a comparatively small proportion of the work promised has been placed, locally at least, but as certain important parts of the announced programme are of a character that cannot be long delayed, it is hoped that before the end of the year some substantial orders will be placed in this district. In such important railway markets as India and South America, too, conditions are reported to be improving for British makers. Sheffield is always keenly interested in the Motor Show, because so many firms are now specialising in the making of steel and tools for the motor industry that its prosperity means a good deal to the city. There is a strong belief among local suppliers to the motor industry that as the result of the recent Show there will be a strongly revived demand for materials.

Plate and Cutlery.

Business in the plate and cutlery trades is considerably brighter. Orders for the colonial seasonal trade are being hurried towards completion in order to be shipped in time to reach their destination before Christmas, and though after this there may be a spell of quietness pending the full development of the home trade for Christmas, it should only prove to be a short one. It is freely reported that stocks held by the wholesale and retail houses are exceptionally light, and that there may be some vigorous buying from important sales centres.

Recent Contracts.

It has been announced that the United Steel Companies, Ltd., has secured a contract for about 40,000 tons of steel rails for the Argentine Government, and that the Cheshire Lines Committee has placed contracts with Charles Roberts and Co. (1927), Ltd., railway wagon and wheel works, Horbury Junction, for 130 open goods wagons, 100 covered goods wagons, 20 cattle wagons and 10 rail and timber wagons.

Coke Ovens to Restart.

Some very useful contracts for cast iron pipes have been secured recently by the Staveley Coal and Iron Company, and it is also well booked up with orders for pig iron. Further evidence of the management's confidence in the continued improvement of trade is the fact that the company has commenced to "warm" a battery of thirty-five coke ovens at its Devonshire works.

Merging of Colliery Companies.

It is officially announced that a controlling interest in the Kiveton Park Coal Company, Ltd., of Kiveton Park, near Sheffield, has been acquired by the Sherwood Colliery Company, Ltd., of Mansfield. No change is to be made in the constitution of the company or the staff, and its trading activities will go on exactly as usual, though the merging of the two concerns, with a combined output of 1,600,000 tons per annum, will strengthen the selling side and lead to certain economies.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipbuilding Hustle.

Within an hour of the steamer Varand being launched on Monday from the yard of Armstrong, Whitworth and Co., Ltd., Walker-on-Tyne, the keel of another vessel had been laid on the same slipway. The feat recalled the feverish haste of the war years, when vessels were built as rapidly as possible to cope with the menace of the German U boats. Immediately the Varand started to slide towards the water an army of workmen followed her and cleared up the *débris* of planks and wooden blocks always left behind by a newly launched ship. Skilfully they placed them in position for the new keel, and within a few minutes derricks were employed raising the keel plates to their places. The first one, weighing 1½ tons, was laid by Miss Beryl Gertrude Weatherby, who a few minutes before had named the Varand. The latter is a tank steamer 427ft. in length, and will have a speed of 11 knots. She is electrically lighted throughout, and her machinery consists of a set of direct-acting surface-condensing triple-expansion engines of the most modern and approved design, which are to be constructed by the North-Eastern Marine Engineering Company, of Wallsend. The outlook in the shipbuilding trade on the North-East Coast is distinctly brighter. Production, however, is rapid in these days, and although there is a good deal of work in hand, builders have to look well ahead in order to secure continuity of work. Prices, it is known, have been low, but the area has participated very satisfactorily in contracts that have been given out this year, and the total tonnage turned out when December closes will reach a substantial figure.

Two More Furnaces Restarted.

Gjers, Mills and Co., Ltd., this week restarted two of the five blast-furnaces at their Ayresome Ironworks, Middlesbrough, one for the manufacture of East Coast hematite iron and the other for ferro-silicon. The works have been wholly idle since May last. There are now forty-one blast-furnaces in operation on the North-East Coast, as compared with seventy-three in 1914.

Cleveland Iron Trade.

Business in the Cleveland pig iron trade just now is somewhat quiet, but the optimistic feeling has not left the market, the prevailing opinion being that the halt in buying is likely to be of brief duration, and that in the very near future resumption of steady business will be experienced. Buyers of several commodities have covered their needs for the time being, but have in a few cases made arrangements for supplies over a lengthy period. Cleveland iron is still being taken up to an extent that cannot be covered by the restricted output, and stocks are consequently being depleted. Prices of continental iron fail to tempt consumers here to buy to any extent, although a little foreign product has been bought recently for use in this area. A large proportion of the make of Cleveland iron is going into direct consumption at producers' own steel works, and local foundries are accepting fair quantities; while odd sales to customers at a distance and to buyers overseas are reported. Prices are firm. For home use No. 1 Cleveland foundry iron is 70s.; No. 3 G.M.B., 77s. 6d.; No. 4 foundry, 66s. 6d.; and No. 4 forge, 66s. Quotations to Scotland, as well as to customers overseas, are 2s. 6d. below the foregoing figures.

Hematite Pig Iron.

The demand for East Coast hematite is still below expectations. Prices vary considerably, but the tendency now appears to be upwards, notwithstanding that more iron is coming on to the market by the restarting of a furnace at the Ayresome Ironworks. There are makers who still have rather large stocks, but accumulations are being steadily reduced. Round about 72s. 6d. is named for mixed numbers, both for home use and export, while No. 1 quality is at a premium of 2s. 6d.

Iron-making Materials.

The foreign ore trade is lifeless. Consumers are well placed as regards supplies for the next six months, and are disinclined to negotiate for delivery further ahead, but sellers have adopted a rather firmer attitude as the result of recent heavy buying on the Continent. Best Rubio ore is nominal at 21s. per ton, c.i.f. Tees. Blast-furnace coke continues slow of sale, and 18s. per ton delivered is a full price for good average qualities.

Manufactured Iron and Steel.

There is little change to record in the manufactured iron and steel trade. Business is quieter, and most descriptions of material are being pressed on the market. Prices are steadily upheld, but a reduction of 10s. has been made in iron rivets, lowering the quotation to £11 5s.

The Coal Trade.

The recent revival of strength in the Northern coal market is well maintained. From whatever cause it may be—eagerness to cover early commitments or other reasons—buyers are more numerous, and second-hand holders are able to command slightly higher prices. In all sections the tone is healthier, business being so much better that operations at many of the collieries are being extended. The German miners' strike in the brown coal areas may have had some effect on the situation. At all events the advance in wages which the German miners have been awarded by the arbitrator following the strike may benefit this district by lessening competition from German coals to some extent. Gas coals are firming up in harmony with steam classes, and the bunker-producing collieries have satisfactory order books for the present. Coking coal is a livelier market, and now what is wanted to give the coal trade a substantial fillip is an improvement in the home demand, notably by the steel

works. Leaving out of account uneconomic prices, the exports are certainly encouraging at the present time, but more inland business is needed. Best Northumberland steams fully maintain 13s. 6d. to 14s., while seconds are a shade stronger at 13s. to 13s. 3d. Durham gas coals show slight appreciation at from 15s. 9d. to 16s. 3d., and the second qualities are firmer at 13s. 6d. to 14s. There have been fairly large sales of coking coal, and 13s. 6d. to 14s. is the current quotation. There is no interruption to the steady advance in coke values, particularly gas cokes, which are in brisk demand, and for delivery up to the end of November supplies are scarce. Makers generally are sold out and contractors offer sparingly at advancing values. Prices range from 23s. to 23s. 6d. Foundry and furnace cokes are firmer in view of a good demand and steadily advancing coal prices.

Ironstone Miners' Wages Reduced.

A settlement was reached on Tuesday in the wages difficulty in the Cleveland mining industry, the men accepting a reduction of 6·3 per cent., as compared with the 9·1 per cent. proposed by the mineowners. Under the new arrangement, which takes effect immediately, the wages stand at 58 per cent. above the base rates. A fortnight ago when the parties met to discuss wage rates for the current quarter they failed to reach an agreement. The owners then claimed that they were entitled to reduce wages by 15·3 per cent., but offered to compromise on a reduction of 9·3 per cent.

SCOTLAND.

(From our own Correspondent.)

Burden of Costs.

The burden of costs is being very frequently referred to in connection with the depression in the steel industry in general, and heavy steel in particular. Foreign competition is keen and difficult to combat, but, on the other hand, rising costs in the nature of municipal and other taxation are serious items. Many attempts have been made and are still being made to bring the serious state of affairs in industry to the notice of municipalities and to other authorities, but little, if any, success has attended such efforts so far, and the burden of taxation continues to grow. Works are being closed down, and it is rumoured that some may eventually be dismantled, but still there is no sign of any measure of relief from the heavy taxation imposed. With plants fully in motion the burden might be met, heavy though it undoubtedly is, but under present conditions, with works partially employed, the situation is greatly aggravated. Thus not only has the producer to face stern competition from foreigners, who have less wages to pay for longer hours worked and considerably lighter transport charges to face, but he has also to encounter rising costs at home. Some products are almost, if not quite, on pre-war levels as regards price, but are yet undercut by the foreigner to the extent of 30s. per ton and more. Consequently, with many municipal elections at hand it is not surprising that a great effort is being made to bring home the need for economy in order to lighten the burden on industry, which is the heaviest taxpayer. At two large works in the West of Scotland operations have been indefinitely suspended during the past week, and hundreds of men thrown idle. A reduction of costs is urgently required if the industry is to be saved, let alone regain its former position.

Wages in the Pig Iron Trade.

As a result of the examination of the employers' books for July, August and September last, the average net selling price of pig iron has been certified as £3 17s. 3d. per ton. Consequently the wages of the men will fall 5 per cent. on basis rates.

Steel.

The scarcity of specifications for heavy steel is still pronounced, and makers are becoming more and more anxious. Work is very irregular, and as has already been mentioned some works have suspended operations and others are contemplating similar action. It has been said that the entire commitments in plates and sections could easily be overtaken by one or two works. Prices are unchanged. Steelmakers have better inquiries for light than heavy sheets, but even the former are not particularly bright at present. The demand for scrap is very restricted.

Iron.

There is no improvement in the bar iron trade. Re-rolled steel bars are somewhat better off, being preferred to iron owing to the cheaper price of the former, but the total amount of work in hand is not reassuring. Prices are unchanged, with re-rolled steel bars quoted about £7 15s. home and £7 7s. 6d. per ton for export. Pig iron is a dull market. Demands are few and stocks in makers' yards continue to accumulate while prices weaken.

Imports and Exports.

During the past week some 14,000 tons of iron ore were discharged at Glasgow, while manufactured iron to the amount of 2600 tons was also dealt with. Shipments of manufactured iron amounted to 5000 tons.

Coal.

With the exception of Lanarkshire ells and splints and Lothians steams all descriptions of round coal are plentiful and prices a matter of arrangement. Washed nuts in all districts have improved their position however. Demands for these on home and export account are growing, and with restricted supplies, due to curtailed outputs of large coal, prices are hardening. Aggregate shipments during the past week amounted to 268,000 tons, against 271,103 tons in the preceding week and 250,088 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

To all outward appearances there has been no change in the conditions prevailing in the steam coal industry. Shipments last week were certainly very satisfactory, inasmuch as the total came to 449,606 tons, which compared with 343,624 tons for the previous week, so that there was a gain of over 100,000 tons. An improvement was looked for, as the daily average of idle tips at the various docks was about thirty-five, whereas during the previous week the total reached the exceedingly high figure of fifty-seven on one day. There are grounds for hoping that the total of shipments for this week will be as high as, if not higher than, last week, as recently quite a fair amount of tonnage has been taken up for readiness this week and next. At the same time, it is singular that the current demand on the market for steam coals opened this week on even quieter lines than had been the case of late, though the actual position of the collieries is better, as the arrivals of tonnage over last week-end were more numerous than they have been for some time. On Monday the total of idle loading appliances was only twenty-one, which in view of recent returns can be accounted very satisfactory. It is possible that the absence of any new inquiry of substantial account from abroad may be due to some extent to foreign buyers holding off as a consequence of the fact that the strike troubles in Germany and Spain have come to an end, and that therefore it might be to their advantage to delay operating in Welsh coals. The inactivity in the fresh demand is certainly disappointing, but there is this to be said that if the conditions on this market are bad, they must be very bad elsewhere. At the moment there is only one inquiry which has occasioned any real interest. The British Admiralty has asked for tenders for its requirements over next year, and the prices had to be in on Tuesday last. This business is very acceptable, although the quantity taken by the Admiralty is very much less than was the case some years ago. It is not expected that the requirements will run to more than about 200,000 tons, whereas the amount was formerly about 1¼ to 1½ million tons annually.

Anthracite Coals for Canada.

The season for shipping anthracite coals to Canada is now rapidly coming to a close. Shipments have lately been speeded up somewhat, as steamers will be unable to load much after the end of this month if they are to get to Montreal and Quebec and discharge their cargoes of coal and load outwards before the St. Lawrence closes. The river is expected to close for navigation owing to the ice at the extreme end of November or in the early days of December. The anthracite trade with Canada becomes of increasing importance every year. At the end of last week a very successful experiment was carried through at the King's Dock, Swansea, in the loading of anthracite. The ss. Glenbridge was taking a cargo of about 5000 tons and she was loaded by what is described as the anti-breakage process, which permits of the coal being sent from the chute on to a disappearing platform, which carries the coal into the holds with a minimum amount of breakage. This is a very important matter, as, if the trade is to be developed, it is essential that the cargoes of coal should arrive in Canada in the best possible condition.

Colliery Development.

The Gwaun-Cae-Gurwen Colliery undertaking, in which Guest, Keen and Nettlefolds, Ltd., have a controlling interest, has for some time been carrying out important development work at its pits, which produce some of the best anthracite in South Wales, and on Friday last Lord Buckland laid the foundation stone of the new Buckland pit and Sir David R. Llewellyn, Bart., officially opened the new Steer pit. The company has installed the very latest plant at these pits, and electricity will be extensively used in the hauling of the coal and its movement when it reaches the surface. The Steer pit is sunk to a depth of 339 yards, and the washing, breaking and screening plant is designed to deal with 900 tons per shift. The intention is to sink the Buckland pit to the lower measures at a depth of 600 yards, and the total production of the collieries will be brought from 300,000 tons per annum to 800,000 tons per annum, when the developments now in progress are completed.

Tin-plate Trade.

The state of the tin-plate trade of South Wales has been a matter of considerable anxiety to manufacturers for some time past. Reference has already been made to the fact that the pooling scheme as a means of stabilising the industry has not been attended with the success at one time expected, but there is also the very disturbing factor of increasing competition on the part of United States manufacturers, whilst continental manufacturers are increasing their production to the disadvantage of this district. It is stated that one of the causes of the increase of the production and export from the United States is an improvement in the rolling of the bars for the purpose of tin-plate manufacture. The seriousness of the position generally resulted in a manufacturers' meeting last week appointing a committee to go thoroughly into the problem. This committee consists of Mr. Frank Rees, managing director of the Llanelly Steel Company, Ltd.; Mr. Frank W. Gilbertsen, of W. Gilbertson and Co., Ltd.; Sir Edgar Jones, of the Welsh Plate and Sheet Manufacturers' Association; and Mr. L. D. Williams, of Deloitte Plender, Griffiths and Co., chartered accountants; while Mr. Hugh Ingledew, of Cardiff, has been appointed legal adviser to the committee.

Steel and Tin-plate Depression.

Moving the adoption of the annual report at the meeting of the Swansea Metal Exchange on Tuesday, Mr. Frank Rees, the chairman of the South Wales Siemens Steel Association, gave a review of the trading conditions, and said that as regarded the steel and tin-plate industries, they in South Wales were passing through a period of gloom and despondency unequalled during the last twenty-five to thirty years. Dealing with American progress, he said that remarkable developments were taking place in America in connection with continuous sheet manufacture. While they in this country were alarmed they were not at a standstill. At their own works at Llanelly they had installed a continuous mill which at the moment seemed the last word, for it was the most modern bar mill in the whole of this country. He was at liberty to say that there was an important movement on foot at the moment in South Wales which, if successful, would show to the world that they were determined to be in the forefront of the steel makers of the world, with the most modern and up-to-date plants and methods. He was perfectly satisfied that they were on the right track.

Steel Trade Wages.

The usual three-monthly ascertainment of prices in the South Wales Siemens steel trade, on which are based the wages in the local steel and tin-plate industries, has just been made known. It shows the average selling price of steel bars, f.o.t. makers' works, to have been £5 13s. 0½d., which is equivalent to 6½ per cent. on the sliding scale. Compared with the previous quarter, this means a decline of 5 per cent. in wages, but it is probable that this reduction will not affect the lower-grade workmen in either industry.

Coal Inquiry.

The Egyptian State Railways are in the market for 100,000 metric tons of large steam coals. Tenders have to be received on December 1st.

Stabilising Coal Prices.

The Sub-committee of the South Wales Coalowners' Commercial Committee, appointed to consider a scheme for the stabilisation of coal prices, is understood to have completed its work, and the report has been sent to the members of the Commercial Committee which meets on Monday. The report has to be submitted to the full body of the Coalowners' Association for confirmation or otherwise.

Current Business.

The general tone of the market for steam coals has been very quiet, and is scarcely changed from a week ago. Nominally, prices have not undergone any alteration, as best Admiralty large coals range about 19s. 6d. to 19s. 9d., though small coals are rather more plentiful, and are obtainable at round about 13s. Sized coals continue to be the firmest spot in the market, but the inquiry for both coke and patent fuel is slow. Pitwood is also in meagre demand, and prices are down to 27s., as compared with 33s. a fortnight ago, but the probability is that before very long the market price will show some recovery.

LAUNCHES AND TRIAL TRIPS.

Myson, steamer; built by William Gray and Co., Ltd., to the order of Compagnie de Navigation d'Orbigny; dimensions, 400ft. by 53ft. by 27ft. 6in. Engines, triple-expansion, 26in., 43in., and 71in. diameter by 48in. stroke, pressure 180 lb.; constructed by the builders; trial trip, October 1st.

Zahra, steamship; built by Harland and Wolff, Ltd., to the order of the Vacuum Oil Company, Ltd.; dimensions, 180ft. by 33ft. 9in. by 14ft. Engines, inverted, direct-acting, triple-expansion, pressure 180 lb.; launch, October 5th.

City of Worcester, steamer; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of the Ellerman Lines, Ltd.; dimensions, 413ft. by 53ft. 6in. by 31ft. 4in.; 8980 tons deadweight. Engines, triple-expansion, 23½in., 40½in., 70in., with 48in. stroke; pressure, 220 lb.; constructed by the builders; trial trip, October 7th.

Umberleigh, steamer; built by William Gray and Co., Ltd., to the order of the Tatem Steam Navigation Company, Ltd.; dimensions, 400ft. by 54ft. 3in. by 28ft. 3in. Engines, triple-expansion, 25in., 42in., 70in., with 48in. stroke; pressure, 200 lb.; constructed by the builders; trial trip, October 8th.

Combined Air Heater and Economiser.—In connection with the description of Messrs. Galloway's combined air heater and economiser published in last week's issue, we are informed that the figure of 280 deg. given for the temperature of the air after passing through the plant is lower than is actually realised, because of a defect in the recording thermometer by which it was determined. The true figure, we understand, is in the neighbourhood of 350 deg. and 380 deg. Fah. It should also be stated that the section of the plant given in Fig. 3 represents the large 8ft. 6in. diameter "Supermiser" and not the small 3ft. 10in. plant, as stated in the title.

The Institution of Mechanical Engineers.—Prizes have been awarded by the Council of the Institution of Mechanical Engineers for the following papers read before Graduates' Sections during the session 1926–27:—"An Investigation into the Cylinder Losses of the Locomotive Engine," by E. L. Diamond, B.Sc. (Eng.) (Lond.); "The Latest Advances in Aero-engine Design," by R. M. Hayes; "The Screw Propeller," by F. C. Johansen, B.Sc.; "Parcel and Package Conveying Machinery," by H. W. Cadman; "The Control of Continuous-current Traction Vehicles," by R. F. Clarke. The papers by Mr. Diamond and Mr. Johansen have also been approved for publication in abstract in the Institution "Proceedings."

R.I.B.A. Maintenance Scholarships in Architecture.—The Board of Architectural Education of the Royal Institute of British Architects announces the following awards of R.I.B.A. Maintenance Scholarships in Architecture:—*The R.I.B.A. Fourth and Fifth Year Maintenance Scholarship* has been awarded to C. J. Bartlett of the School of Architecture, the Technical College, Cardiff. The scholarship is of the value of £100, and is tenable for two years. *The A.G.B.I. Maintenance Scholarship* has been awarded to J. F. D. Wylson, of Whitstable, Kent. The scholarship is £100 in value for one year, and is renewable for two further periods of one year each. Six scholarships were awarded in July, 1926, and five of them have been renewed for the academic year 1927-1928.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 16 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 14 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 12 0	3 12 0
No. 1	3 12 6	3 12 6
Cleveland—		
No. 1	3 10 0	3 7 6
Silicious Iron	3 10 0	3 7 6
No. 3 G.M.B.	3 7 6	3 5 0
No. 4 Foundry	3 6 6	3 4 6
No. 4 Forge	3 6 0	3 3 6
Mottled	3 5 6	3 3 0
White	3 5 6	3 3 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 6 0	—
(3) Northampton—		
Foundry No. 3	3 1 0	—
Forge	2 15 0	—
(3) Derbyshire—		
No. 3 Foundry	3 6 0 to 3 7 0	
Forge	3 0 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 6 6 (a)	—
	4 9 6 (b)	—
	4 13 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 15 0	10 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 15 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 12 6 to 10 0 0	
Marked Bars (Staffs.)	13 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 12 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 15 0 to 8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	14 5 0	£13 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 9. 0	
Manchester—		
Bars (Round)	8 10 0	—
„ (Small Round)	7 15 0	—
Hoops (Baling)	10 5 0	10 0 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
„ (Lancs. Boiler)	10 15 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	7 0 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 15 0 to 14 0 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	17/6 to 18/-
Block Tin (cash)	265 15 0
„ (three months)	261 15 0
Copper (cash)	56 0 0
„ (three months)	55 18 9
Spanish Lead (cash)	20 2 6
„ (three months)	20 11 3
Spelter (cash)	26 12 6
„ (three months)	26 6 3
Manchester—	
Copper, Best Selected Ingots	62 17 6
„ Electrolytic	63 0 0
„ Strong Sheets	86 0 0
„ Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
„ Condenser, lb.	0 1 1½
Lead, English	21 12 6
„ Foreign	20 12 6
Spelter	26 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 17 6	7/3
„ „ 8 p.c. to 10 p.c. „	£22 10 0	6/6
„ „ Specially Refined		
„ Max. 2 p.c. carbon	£36 0 0	11/6
„ „ „ 1 p.c. „	£41 10 0	15/-
„ „ „ 0·70 p.c. carbon	£53 0 0	17/6
„ „ „ carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£12 0 0	for home, £16 for export
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0	scale 5/- per unit
„ „ 75 p.c.	£20 5 0	scale 6/- per unit
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/- per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/3
„ „ Ell	14/-
„ „ Splint	14/6 to 16/-
„ „ Trebles	14/6
„ „ Doubles	13/6
„ „ Singles	11/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/6 to 14/-
„ „ Jewel	15/6
„ „ Trebles	14/6 to 15/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 12/9
Screened Navigation	18/-
Trebles	15/- to 16/-
Doubles	13/9 to 14/3
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/9 to 13/-
Secondary Steam	12/- to 12/3
Trebles	14/6 to 15/6
Doubles	14/-
Singles	12/3

ENGLAND.

(8) N.W. Coast—	
Steams	24/- to 25/-
Household	40/- to 56/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/6 to 14/-
Second Steams	12/9 to 13/-
Steam Smalls	9/6 to 10/-
Unscreened	13/- to 13/6
Household	21/- to 27/-
Durham—	
Best Gas	16/-
Second	13/6
Household	21/- to 27/
Foundry Coke	19/- to 26/-

Sheffield—	Inland.	
Best Hand-picked Branch	28/- to 30/6	—
Best Selected House Coal	22/6 to 23/-	—
Screened House Coal	19/- to 20/-	—
„ „ Nuts	16/- to 17/6	—
Yorkshire Hards	14/6 to 16/6	—
Derbyshire Hards	15/- to 17/-	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	3/- to 4/6	—
Blast-furnace Coke (Inland)	12/6 at ovens	—
Furnace and Foundry Coke (Export) f.o.b.		19/- to 20/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/6 to 20/-
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/6 to 19/-
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	17/9 to 18/-
Western Valley Large	17/6 to 17/9
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/6 to 20/-
„ „ Smalls	15/6 to 16/6
No. 2 „ Large	16/6 to 17/-
„ „ Through	15/- to 15/6
„ „ Smalls	13/- to 14/-
Foundry Coke (export)	35/- to 40/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	23/- to 24/6
Pitwood (ex ship)	27/6 to 28/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 36/-
Seconds	28/- to 30/-
Red Vein	24/6 to 26/-
Machine-made Cobbles	37/6 to 42/6
Nuts	42/6 to 45/-
Beans	27/- to 30/-
Peas	18/6 to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/3 to 8/9
Steam Coals:	
Large	18/6 to 19/-
Seconds	17/- to 18/-
Smalls	10/6 to 12/-
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Steel Organisation.

THE situation of steel makers all over the Continent, except perhaps in Germany, where the home demand is at present sufficient to absorb the production, has become so serious that there is believed to be no hope of salvation other than in an organised output of steel and the sale of steel products in foreign markets. The whole future now turns upon the carrying out of some arrangement for the constitution of the *comptoir*, the fate of which appears to be seriously compromised by the exactions of two Belgian producers in the Charleroi district. The Germans have gone as far as they can in the way of concessions by offering Belgium 20,000 tons of their quota, and as the Belgian rolling mill owners are unable to settle the participation amongst themselves it was feared, at one moment, that any hope of constituting the *comptoir* must be abandoned. Since then matters have been going from bad to worse, with a diminishing consumption and prices falling to an unremunerative level. It is certain that if this state of things is allowed to continue many firms will be obliged still further to reduce their production, or there may be a disastrous cutting of prices, and it is with a view of avoiding such an alternative that efforts are again being made to arrive at a compromise which will provide everyone with a share of the work available at remunerative prices. Most of the Belgian makers themselves are alive to the seriousness of the outlook, and are endeavouring to bring the two dissentient firms into line so as to be able to complete negotiations for the *comptoir*. It is believed that, if necessary, other countries may be induced to follow the example of Germany and offer concessions, and that a means will be found of creating the international sales' organisation which can alone prevent a ruinous competition amongst rollers of steel sections. Following upon the dissolution of the Union of wire drawers and nail makers, the Germans, the Arbed in Luxemburg and Ougrée-Marihaye have settled upon what is termed "a gentleman's agreement," leaving the Dutch and Czecho-Slovakian makers and the Clouteries et Tréfileries de la Paix to take what action they please. The Clouterie de la Paix is under the control of a Lorraine group, and it withdrew from the Union because it could not obtain a larger participation. It is difficult to see how the Germans can save the situation in view of the heavy production of nails and wire that the Belgian and Dutch firms are capable of putting on the foreign markets.

Continuous Brakes.

There is some difficulty in settling arrangements for the orders which are to be given out for the equipment of goods trains with continuous brakes. The Germans expected that they would be required to supply the whole of the equipment, only a part of which would be on account of reparations, but it is understood that at a recent meeting of the Technical Commission on Reparations, it was decided that one-half of the brakes will be obtained in Germany and one-half ordered in France, while French makers will also supply the accessory parts. It is estimated that 523,786 wagons will be equipped with the new brakes at an approximate cost of 1600 million francs.

Tunnelling the Pyrenees.

The railways which are to traverse the Basses-Pyrenées and the Pyrenées-Orientales and connect up the French and Spanish railway systems are so far advanced that one is expected to be opened in the coming spring and the other in the middle of 1929. The line from Pau to Orloron and Bedous is continued by a series of viaducts along the Gave and then passes through a tunnel 1700 m. long, forming two loops, so as to make a difference of 60 m. between the levels of the two openings. Here a station is being constructed. The line then passes through a tunnel 5¼ miles long under the Col de Somport. On the other side of the tunnel is the international station of Canfranc. The railway follows a much easier route on Spanish territory to Jaca, where it joins up with the railway to Saragossa. On the second railway, which will follow the Ariège and traverse the Pyrenées towards Barcelona, the Midi Railway Company found it necessary to build a line between Bourg-Madame and Tour-de-Carol in order to bring the material for the construction of the new railway which starts from Ax-les-Thermes. On the rails and sleepers being brought to the Cabannes Station they are assembled in sections 22 m. long and are then conveyed to Ax-les-Thermes, where they are laid at the rate of 350 m. a day. The route is a difficult one, necessitating short radius curves and a number of tunnels, the one at Saillens being looped to give a difference of 100 m. in altitude between the two ends. The maximum altitude is reached at Puymorens, where the tunnel has a length of 3¼ miles. On the other side, the railway follows the Carol Valley on a series of viaducts and reaches Tour-de-Carol, where it joins the Spanish system. The railways will be electrified throughout.

Foreign Trade.

The returns of foreign trade during the first nine months of the year are regarded as satisfactory because they show an excess of export values over imports, but that is due again to the heavy fall in the value of raw material imported, there being an increase of 1,702,720 tons and a diminution in value of 6246 million francs. This is attributed largely to the cheaper coal. On the other hand, there was an increase in the exports of raw material of 3,318,725 tons and an increase in value of only 442 million francs, while there was an augmentation of 524,590 tons of manufactured goods and a declension in value of no less than 3077 million francs. This implies the consignment abroad of cheaper rolled iron and steel. The total value of imports during the nine months was 38,529 million francs, a declension of 5731 million francs as compared with the similar period of 1926, while exports were valued at 40,283 million francs, a diminution of 2492 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

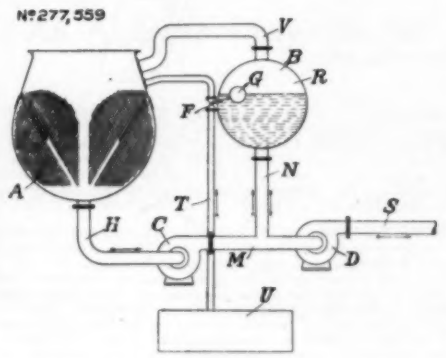
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

277,559. February 26th, 1927.—CLOSED FEED SYSTEMS, G. and J. Weir, Ltd., Cathcart, Glasgow, and C. R. Lang.

It is suggested in this specification that in some marine installations it is inconvenient to have a hot well below the level of the condenser of such a capacity as will accommodate the variations in the demand for feed water of the boilers. An alternative is illustrated. A is the main condenser, C is a suction head pump which withdraws the feed water from the condenser through the pipe H and delivers it into the pipe M which leads to the water-extraction pump D, and has an upwardly extending branch N which leads to the elevated feed reservoir R. An equilibrium pipe V connects together the steam spaces in the reservoir R and the steam condenser, so as to maintain the same pressure in the former as in the latter. Except for flow up or down the pipe N to meet irregularities,

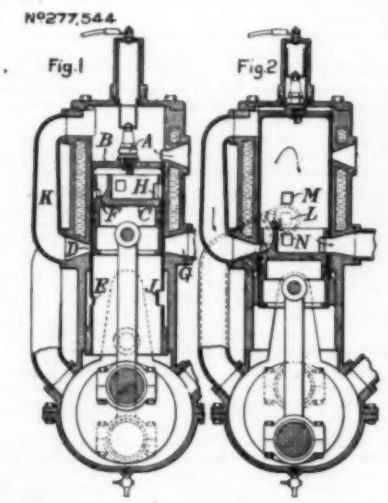


the pump D delivers all the feed water into the main feed conduit S. The boiler and boiler feed pump are not shown. The reservoir R contains a float G, which by a suitable mechanism controls a valve F placed on the pipe T, which connects the reserve feed tank U with the condenser. When, owing to a reduced delivery of water into the boiler, the pressure rises in the main feed conduit, and hence in the pipe M, there is a flow of water into the reservoir R, and, under the opposite conditions, there is a flow from the reservoir R into the pipe M. A certain predetermined range of water level in the reservoir is provided for. When the water level falls below the predetermined low level the valve F is opened and a flow of water takes place from the reserve feed tank into the condenser. By these means it will be seen that fluctuations in the working of the system are provided for, and water admitted to the system only when necessary and then automatically.—*September 22nd*, 1927.

INTERNAL COMBUSTION ENGINES.

277,544. January 31st, 1927.—TWO-STROKE ENGINES, J. H. Crary, Broadway, and Orchard-street, Flushing, New York.

This engine has two pistons, working one within the other and connected by connecting-rods with opposed cranks. The explosion space is that between the two pistons. Its operation is described as follows:—Fig. 1 shows the position of the pistons for firing. A spark from plug A ignites the compression mixture, and the pistons B and C move in opposite directions until the ports D, E, and F are in register, and also the ports G, H and J are in register. As soon as these ports begin to

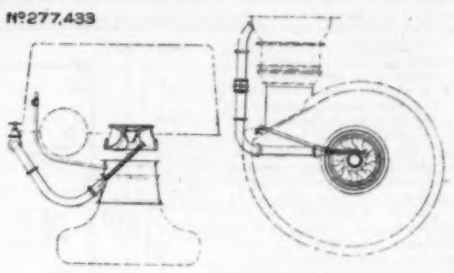


register, air is forced from the upper end of the cylinder through the passage K into the chamber between the pistons and operates thoroughly to force out the burnt gases and ensure a complete scavenging of the engine. This position is indicated in Fig. 2. As the pistons move towards each other, the inlet ports L, M and N will be brought into register, and a rich gas will be forced into the chamber between the pistons and trapped therein, and thoroughly commingled with the air already in the chamber, so that this mixture is compressed as the pistons move toward each other and the firing operation repeated as above explained.—*September 22nd*, 1927.

TURBINE MACHINERY.

277,433. June 18th, 1926.—STOPPING HYDRAULIC TURBINES, The English Electric Company, Ltd., 28, Kingsway, London, W.C. 2, and P. W. Seewer, 11, Wildwood-road, London, N.W. 11.

Where it is desired to shut down a hydraulic reaction turbine, particularly when coupled to an electric generator, it is necessary, the inventors say, to provide some means of absorbing quickly the energy stored in the rotating masses in order that they may be brought to rest within a short time. With this object in view it has been the practice to provide mechanical brakes to be applied to

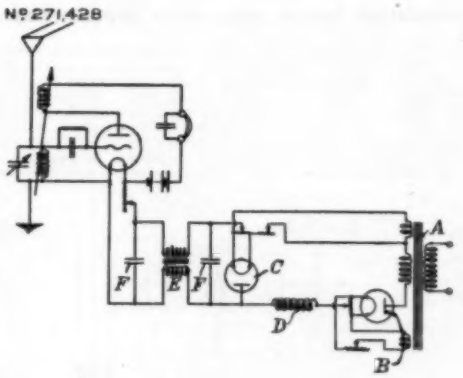


rotating surfaces and produce the absorption of the energy by solid friction. In accordance with the invention a hydraulic brake is provided by projecting free jets of water against the blading of the runner of a reaction turbine in such a direction or directions as to produce on the runner impulses which oppose its rotation in the normal running direction. These jets can be brought into action on the outlet side of the runner and may be directed towards the runner either axially or transversely, as is indicated by the drawing.—*September 19th*, 1927.

TELEGRAPHS AND TELEPHONES.

271,428. April 25th, 1927.—IMPROVEMENTS IN OR RELATING TO AN ELECTRIC CIRCUIT ARRANGEMENT FOR SMOOTHING RECTIFIED ALTERNATING VOLTAGES, N. V. Philips' Gloeilampenfabrieken, Emmasingel 6, Eindhoven, Holland.

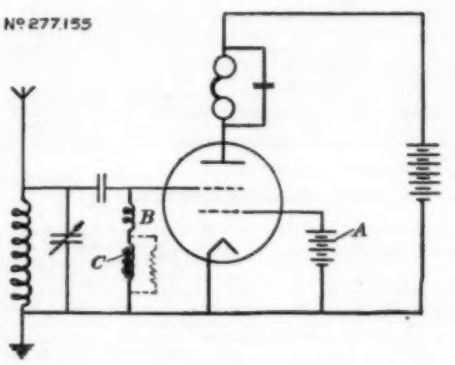
The method of smoothing rectified alternating current voltages in accordance with this invention involves the use of valves in which there is an arc discharge. One end of the secondary of the transformer A is connected to the plate B of a valve which has its cathode fed from an auxiliary winding on the transformer,



the other end of the secondary winding being connected *via* a valve with an arc discharge and an inductance D to the cathode of the valve B in the manner shown. The filament of the valve C is fed by a second auxiliary winding on the transformer. The valve C is connected to a smoothing device consisting of a choke E and two condensers F. The remainder of the circuit is self-explanatory. The valves B and C are filled with one or more rare gases and one or more metal vapours. In each case the cathode is coated with an oxide capable of emitting electrons at low temperature.—*September 15th*, 1927.

277,155. August 5th, 1926.—IMPROVEMENTS IN OR RELATING TO THERMIONIC RECTIFIERS, Harold Lister Kirke, of 11, Newburgh-road, Acton, London, W. 4.

This specification describes a thermionic rectifier having substantially a linear characteristic over a wide range of input energy; that is to say, if a graph be plotted between the applied alternating-current voltage and the resultant direct-current, the graph will be substantially a straight line over a wide range of the applied alternating-current voltage. It will be seen that



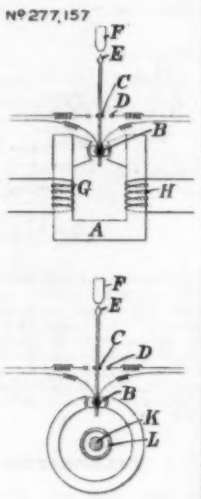
the valve has two grids and that one of them is maintained at a suitable positive potential by a battery A. A high-frequency choke B and a low-frequency choke C are connected in series between the upper grid and the cathode. This grid and the cathode may be regarded as constituting a two-electrode rectifier of the Fleming type, the other grid being added for the purpose of controlling the relation between grid voltage and grid current between the upper grid and the cathode. The device is said to be more sensitive than the usual leaky grid rectifying device,

and the quality of reproduction is also claimed to be far superior. Moreover, the percentage of modulation used at the transmitting station may be raised to as near to 100 per cent. as may be practicable without the quality of the received music or speech being in any way impaired.—*September 15th*, 1927.

MEASURING AND TESTING INSTRUMENTS.

277,157. August 12th, 1926.—Improvements in and relating to Electrical Relays, William Herbert Apthorpe and Cambridge Instrument Company, Ltd., both of Sydney-road, Muswell Hill, London, N. 10.

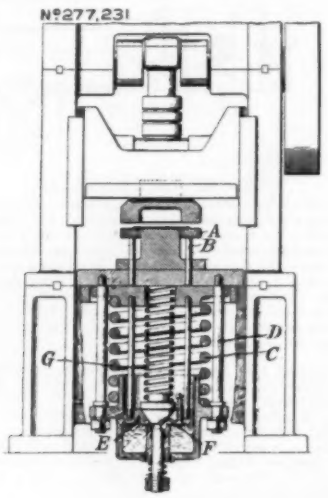
According to this invention, a more definite and otherwise better relay circuit closing contact is obtained than that which is commonly met with. The magnetic yoke piece A acts upon a moving coil mechanism B. The pointer carries a contact C forming the moving contact of a relay circuit and is arranged to approach a fixed contact D when the pointer is deflected. The end of the pointer carries a small piece of magnetic material E, which in the zero position of the pointer is adjacent to the fixed magnet F. The coil B in series with a resistance is energised by a shunt current from a pair of mains, and the poles of the yoke piece are energised in reverse directions by the coils G and H which carry the currents of the respective mains. In the lower arrangement a ring of soft iron is used instead of the yoke A and the coil B is arranged in the gap. The two supply feeders K and L are arranged concentrically. They pass through the centre of the ring and carry current in opposite directions. If the current through one conductor differs from that through the other, as the result, for example, of leakage, a flux will be produced in the ring and the pointer will be deflected. The tractive power of the fixed magnet F is such that when the currents in the mains differ by a predetermined amount the deflecting torque of the electro-magnetic system is just sufficient to overcome the tractive force of the fixed magnet. The two contacts are therefore brought together in a definite manner and are pressed together with considerable force.—*September 15th*, 1927.



MACHINE TOOLS AND SHOP APPLIANCES.

277,231. March 2nd, 1927.—Presses for Drawing Sheet Metal, H. D. Fitzpatrick, 94, Hope-street, Glasgow.

Although the draughtsmanship of this specification is rather obscure, we endeavour to give a rough idea of the invention. The aim is, apparently, to provide a draw plate which will hold the edges of the blank with an approximately constant pressure while the blank is being pressed between the usual dies. The presser plate is shown at A and is supported by pegs B on the platen. This platen is carried by the spring C and, through



the intervention of the rods D, by the hydraulic piston E. This piston works in a cylinder and could not descend if its contents were not allowed to escape *viâ* the valve F, which is held on its seating by the spring G. It will be observed that as the presser plate and the piston E descend in the process of drawing, the spring C resists the movement progressively, but at the same time the valve F is steadily relieved so that the resultant opposition is normal. At the end of the operation the spring C returns the presser plate and strips the finished article.—*September 15th*, 1927.

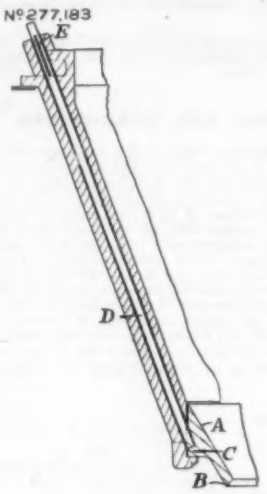
MISCELLANEOUS.

262,443. December 2nd, 1926.—Improvements in and relating to Electric Condenser and Methods of Manufacturing the same, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.* 2.

According to this invention, compressed wood is used as a dielectric for condensers. The wood is impregnated with such material as transil oil or with material having high permitivity, such as nitrobenzene, nitrotoluene, acetonitrile, and the like. Preferably a light, readily compressible wood, such as balsa wood, is first cut, seasoned, dried, and vacuum treated to free it from volatile impurities. It is then impregnated with a dielectric material, such as transil oil, or with a dielectric material having high permitivity, such as nitrobenzene, nitrotoluene, acetonitrile, asphalt, &c., after which it is compressed to any desirable thickness. Balsa wood may be readily compressed to one-half its thickness. The advantage of impregnating the wood before compressing it is that complete saturation of the wood is ensured. The wood may be used as a separator for the plates of a condenser. The dielectric material with which the balsa wood is impregnated should preferably be free from impurities, such as water, acids, &c., to such an extent that its resistivity is of the order of 10^6, or over, in ohms per centimetre cube.—*September 15th*, 1927.

277,183. October 12th, 1926.—Hoppers for Blast-furnaces, W. Marley, 14, Rosehill, Harrington, Cumberland.

The blast-furnace hopper concerned in this invention is of the type in which its lower opening is closed by a bell or cone bearing upwardly against a renewable ring. In the drawing a cross section of one side of the hopper is shown, with the renewable ring at A.



(The bell is not shown, but it makes the joint with the face B.) The ring is supported by the flange C and is held in place by a series of rods, one of which is shown at D. These rods have cotters E at the top, with which they can be pressed down on to the flange C. The cotters can also be used to pull out the rods by driving them into alternative slots.—*September 15th*, 1927.

277,577. April 28th, 1927.—Improved Method for the Production of Insulating Materials, Wilhelm Zimmermann, of Hasslinghausen, Kreis Schwelm, Germany.

A method is described in this specification for the production of yarns or threads for insulating purposes from magnesium-containing mineral substances, such as hornblend, dolomite, magnesite, steatite, &c., with or without the addition of fluorspar, The material is fused in a metallurgical furnace. The molten mass is passed over a stream of steam or compressed air and torn into threads. The product has the advantage that it is not attacked by acids and it is capable of resisting high temperatures.—*September 22nd*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Faraday House Old Students' Association.—Savoy Hotel, Strand, London, W.C. 2. Nineteenth annual dinner.

Institution of Chemical Engineers.—Institution of Civil Engineers, Great George-street, Westminster, London, S.W. 1. Lecture, "Crystallisation," by Sir William Bragg, F.R.S. 6.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Sackville-street, Manchester. Paper, "Locomotive Performance and its Influence on Modern Practice," by Mr. E. C. Poultney. 7 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Engineering in the United States of America," introduced by Mr. L. St. L. Pendred. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Informal meeting. Display of technical film illustrating the production of cotton goods. 7.30 p.m.

Keighley Association of Engineers.—Temperance Institute, Keighley. Lecture, "Modern Methods of Gauging and Size Control," by Mr. J. E. Baty. 8 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Newcastle-upon-Tyne. Annual general meeting. Presidential address by Mr. Maurice S. Gibb. 6 p.m.

Physical Society.—Imperial College of Science, South Kensington, London, S.W. 7. Papers: "Theory of Liquid Flow Through Cones," by Dr. W. N. Bond; "The Structure of Smoke Particles from a Cadmium Arc," by Mr. H. P. Walmsley; a demonstration of an improved mercury vapour trap will be given by Captain G. I. Finch. 5 p.m.

SATURDAY, OCTOBER 29th.

Institution of Automobile Engineers.—London Graduates' visit to the works of Clement-Talbot, Ltd., Barlby-road, Ladbroke-grove, London, W. 10. 2.30 p.m.

Institution of Civil Engineers: Birmingham and District Association.—Visit to the works of the Birmingham Tame and Rea District Drainage Board at Saltley and Minworth. 2 p.m.

North of England Institute of Mining and Mechanical Engineers: Associates' and Students' Section.—Neville Hall, Newcastle-upon-Tyne. Papers: "Variable speed Gears and their Application for Colliery Purposes," by Mr. W. S. Armstrong; and "Feeding and Treatment of Animals Below Ground and Stabling," by Mr. W. S. Rider. 3 p.m.

MONDAY, OCTOBER 31st.

Bradford Engineering Society.—The Technical College, Bradford. Lecture, "Pyrometers for Boiler Flues, &c.," by Mr. W. Bowen. 7.30 p.m.

TUESDAY, NOVEMBER 1st.

Institute of Metals: North-East Coast Local Section.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. "Mechanical Properties of Metals at High Temperatures," by Mr. G. Burns. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Presidential address, by Mr. E. F. C. Trench. 6 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Reduction of Steel Works Costs by Means of Waste Heat Boilers," by Mr. F. Jones. 7.30 p.m.

WEDNESDAY, NOVEMBER 2nd.

Institution of Automobile Engineers.—Queen's Hotel, Coventry. Joint meeting of Birmingham and Coventry Centres. Presidential address, "The Influence of the Automobile User upon the Automobile Engineer," by Major E. G. Beaumont, 7 p.m.; followed by dinner at 8 p.m.

Institution of Electrical Engineers.—Savoy place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Opening address by the Chairman, Lieut.-Colonel A. G. Lee. 6 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Address, "The Royal Society of Arts: Its Services to Trade and Training," by Sir Philip Magnus, Chairman of the Council. 8 p.m.

THURSDAY, NOVEMBER 3rd.

Institution of Automobile Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Joint meeting with the Royal Aeronautical Society. Paper, "High-speed Compression Ignition Engine Research," by Mr. H. B. Taylor. 7.45 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Higher Steam Pressures and their Application to the Steam Turbine," by Messrs. A. H. Law and J. P. Chittenden. 6 p.m.

FRIDAY, NOVEMBER 4th.

Institution of Locomotive Engineers: North-Eastern Centre.—Hotel Metropole, Leeds. Chairman's address, "The Evolution of the Locomotive," by Mr. G. A. Musgrave. 7 p.m. Visit to the Airedale Foundry of Kitson and Co., Ltd., to inspect the Kitson-Still locomotive. 3 to 5 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Thomas Hawksley lecture, "Application of X-rays to the Study fthe Crystalline Structure, of Materials," by Sir William H. Bragg. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Engineering Salesmanship," by Mr. Robert Lowe. 7.30 p.m.

SATURDAY, NOVEMBER 5th.

Institution of Municipal and County Engineers.—Town Hall, Lloyd-street, Llandudno. North Wales District meeting at Llandudno. 10 a.m.

MONDAY, NOVEMBER 7th.

Liverpool Engineering Society.—Applied Electricity Laboratories, The University, Liverpool. Joint meeting with the Liverpool Centre of the Institution of Electrical Engineers. "The Applications of Electricity in Warships," by Mr. W. McClelland. 7 p.m.

TUESDAY, NOVEMBER 8th.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. Paper, "A New Type of Solid Injection Double-acting Two-stroke Oil Engine," by Dr. F. Sass. 6.30 p.m.

WEDNESDAY, NOVEMBER 9th.

Institute of Metals: Sheffield Local Section.—Applied Science Department of the University, St. George's-square, Sheffield. "Application of X-ray to the Study of the Crystalline Structure of Materials," by Sir W. H. Bragg. Thomas Hawksley Lecture. By invitation of Institution of Mechanical Engineers. 7.30 p.m.

Institute of Metals: Swansea Local Section.—Thomas Café, High-street, Swansea. "Pyrometers in Works Practice," by Mr. Peter MacNair. 7 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Mappin Hall, St. George's-square, Sheffield. Thomas Hawksley Lecture, "The Application of X-rays to the Study of the Crystalline Structure of Materials," by Sir William H. Bragg. 7.30 p.m.

THURSDAY, NOVEMBER 10th.

Institute of Metals: London Local Section.—Royal School of Mines, South Kensington, London, S.W. 7. "Some Metallurgical Problems of the Electrical Industry," by Dr. C. C. Paterson. 7.30 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. Thomas Hawksley Lecture, "The Application of X-rays to the Study of the Crystalline Structure of Materials," by Sir William H. Bragg. 7.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Alfred Herbert, Ltd., Coventry, asks us to announce that it has purchased the goodwill, drawings, patterns and other assets of the Hey Engineering Company of Hendon, Middlesex. Mr. Geo. Hey has joined the staff of Alfred Herbert, Ltd.

The Consolidated Pneumatic Tool Company, Ltd., of Egyptian House, 170, Piccadilly, London, W. 1, asks us to state that its works telephone exchange has been altered from Western to Fulham. The number is the same as before, namely, 5121-2-3.

Sir J. H. Biles and Co., of Broadway Chambers, 40, Broadway, Westminster, S.W. 1, announce that Eng. Rear-Admiral Scott Hill has joined the staff of that firm. Eng. Rear-Admiral Scott Hill retired from the Navy after promotion to that rank in April last.

CONTRACTS.

The Westinghouse Brake and Saxby Signal Company, Ltd., has received from the Southern Railway Company an order for power signalling material for London Bridge and Borough Market Junction. The order includes a 311 lever all-electric locking frame, a 35-lever locking frame, and 155 electric point lay-outs. Four-aspect light signals, resonated impedance bonds, and projector type route indicators will be used.

Messrs. Hartley, Sons and Co., of Stoke-on-Trent, inform us that the Municipality of Karachi has accepted their tender for the supply of motor-driven mechanical rake screens, detritus elevators, sludge pumps, valves, penstocks, and electrical equipment, &c., for its main drainage scheme. The same firm has received from the Leamington Corporation an order to supply fourteen automatic "Cygnet" turbine circular sewage distributors 103ft. diameter.